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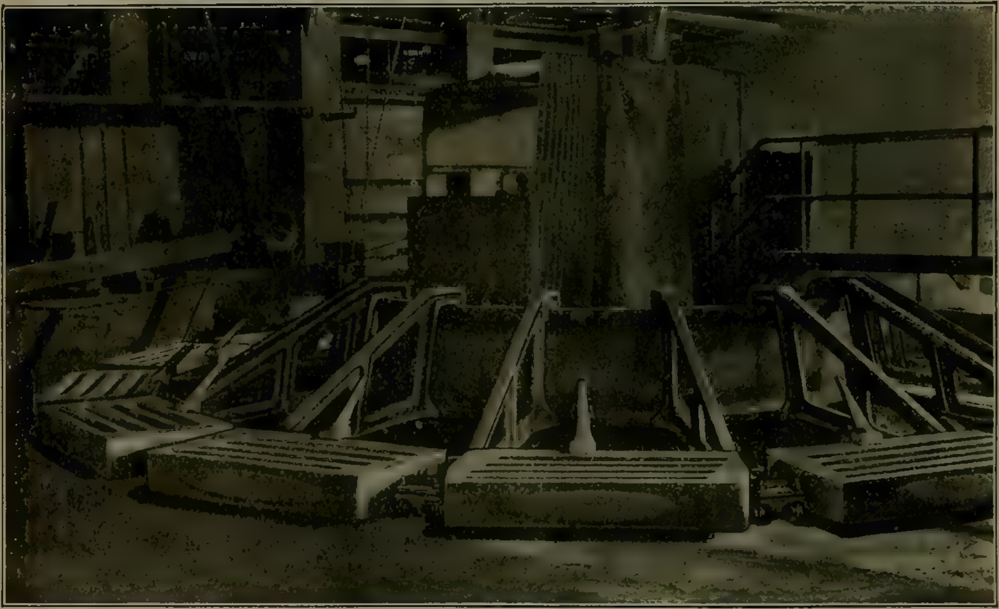

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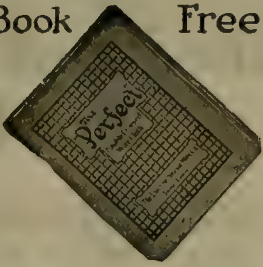

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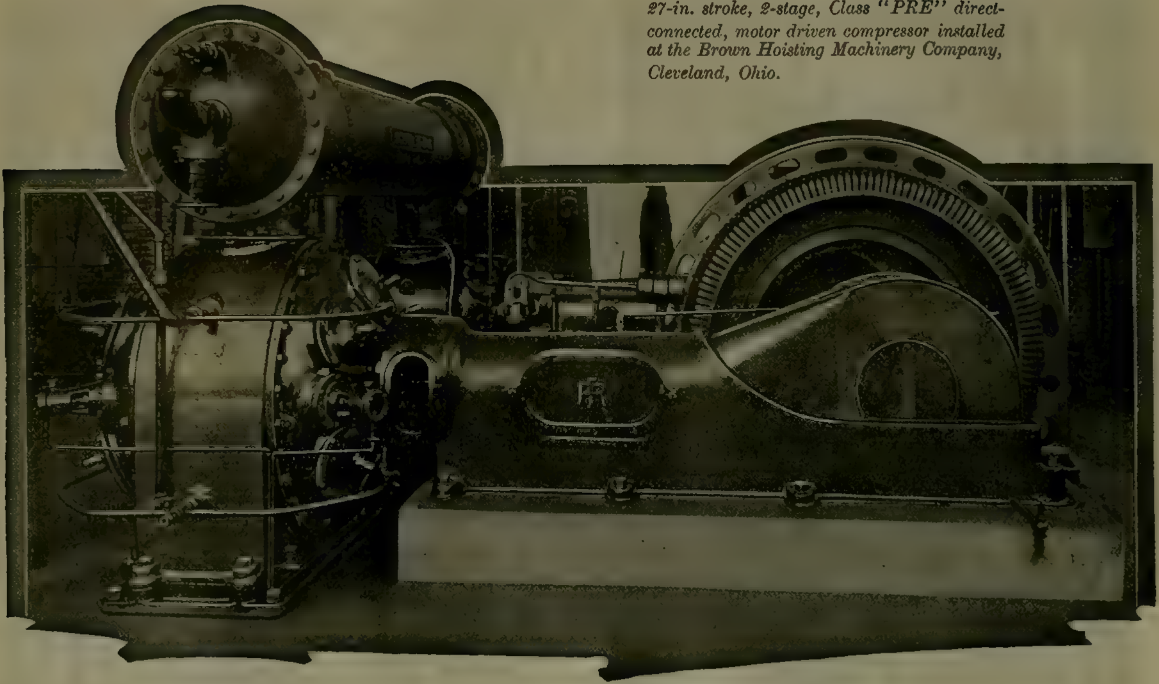

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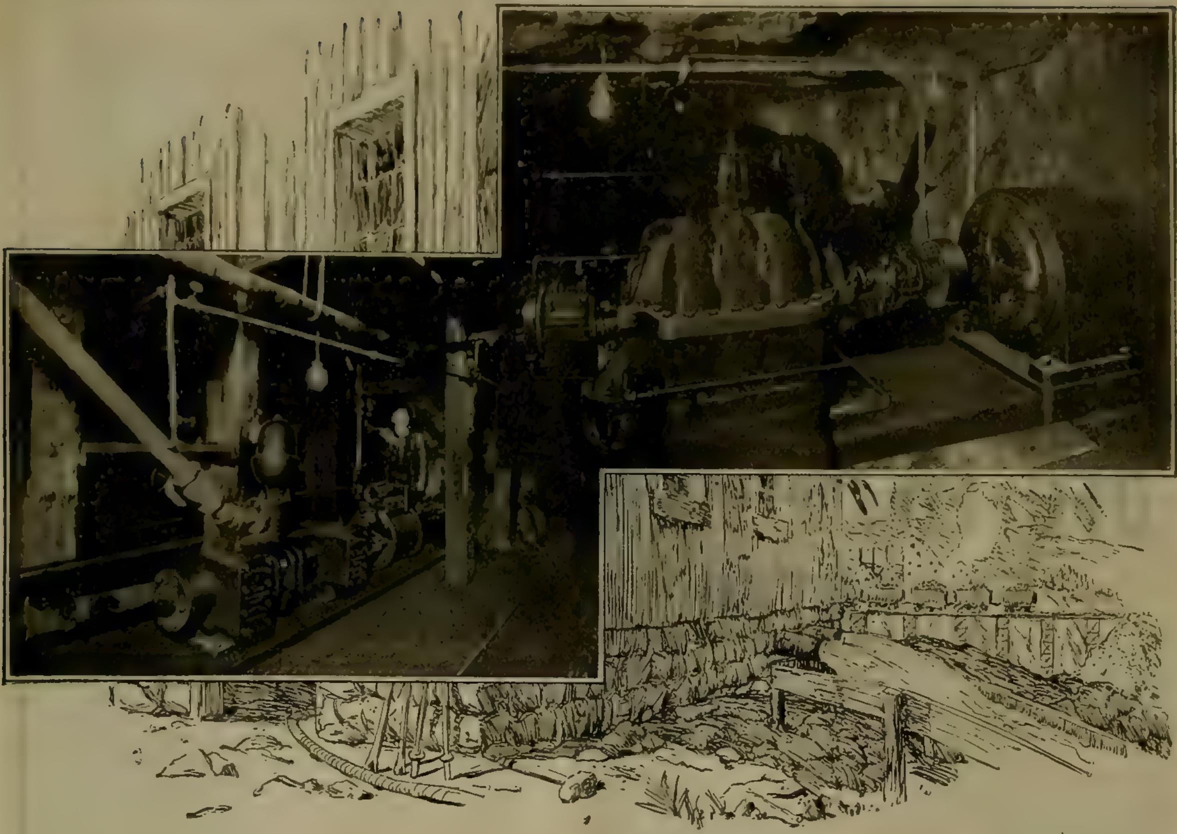

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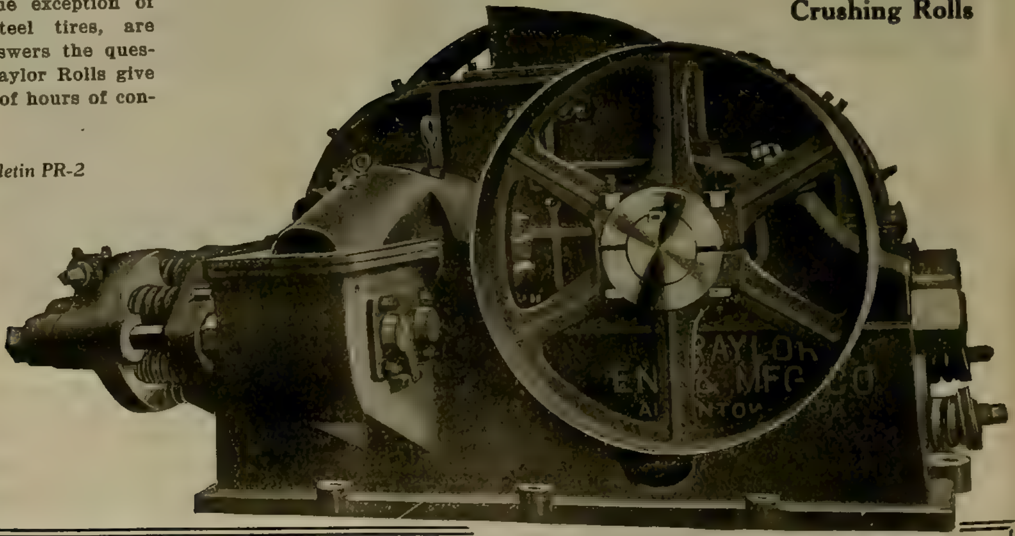

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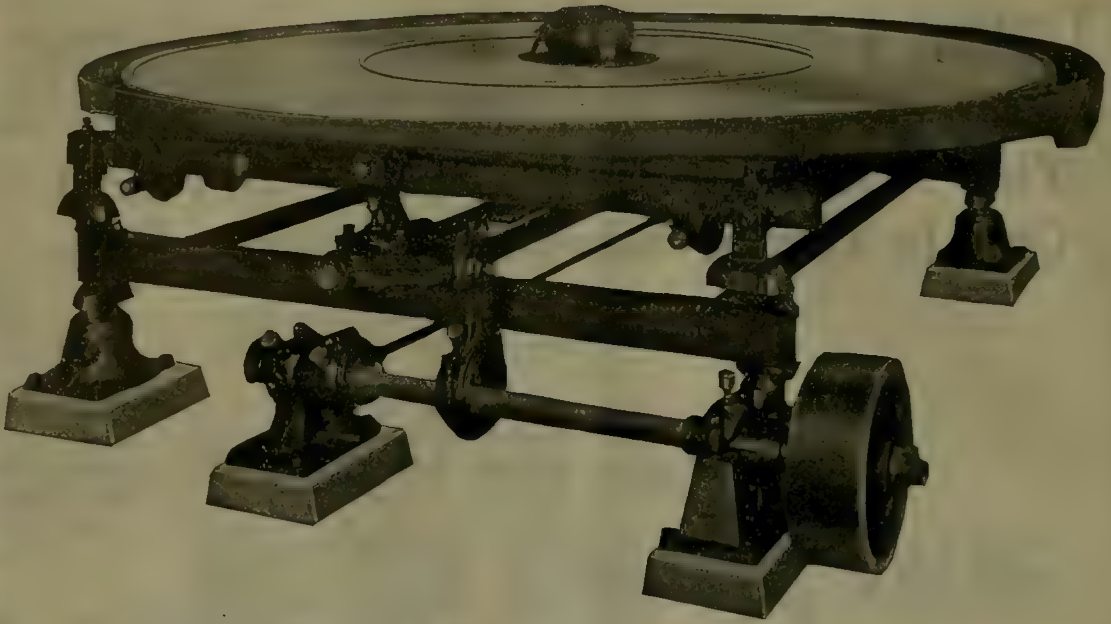

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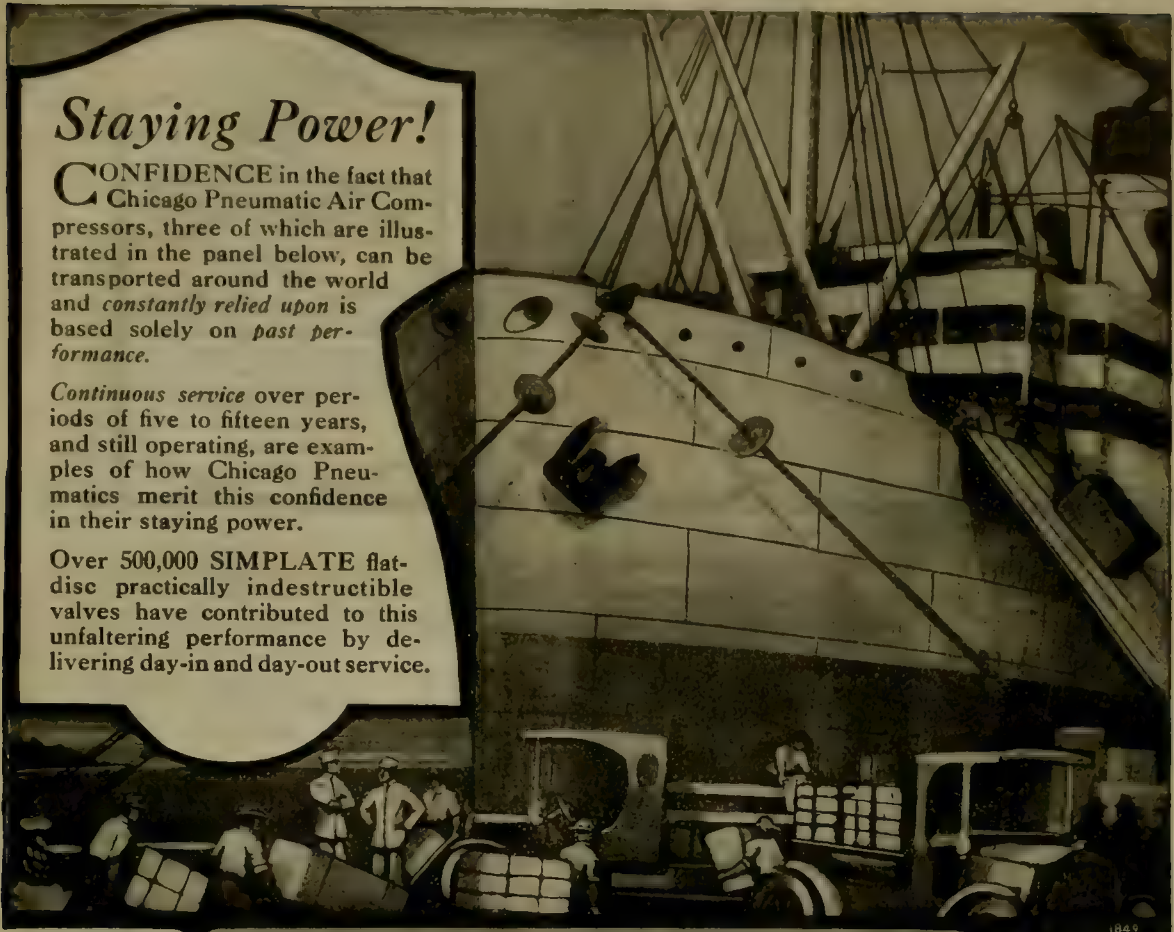

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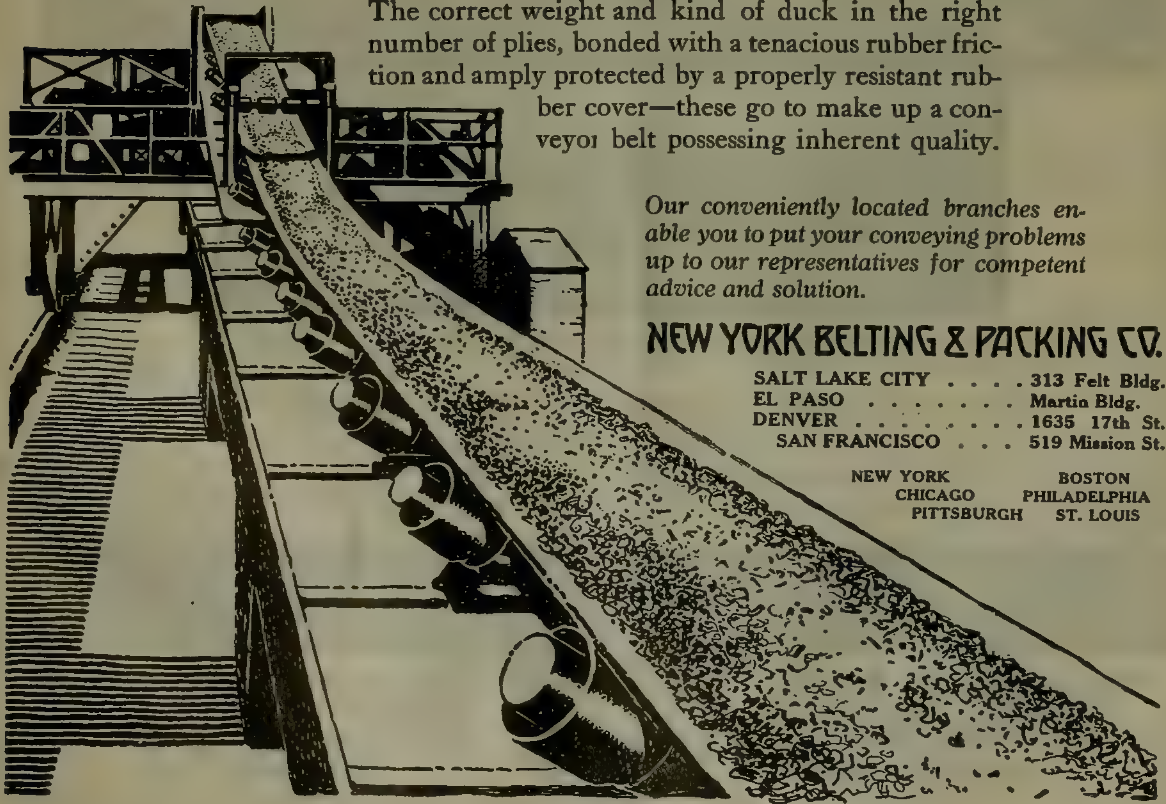

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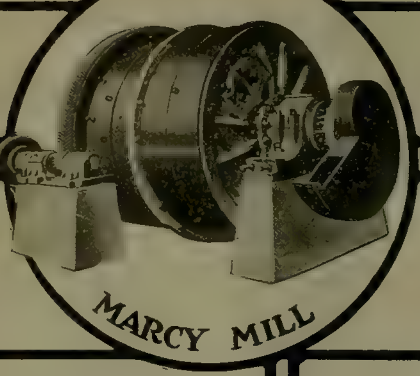

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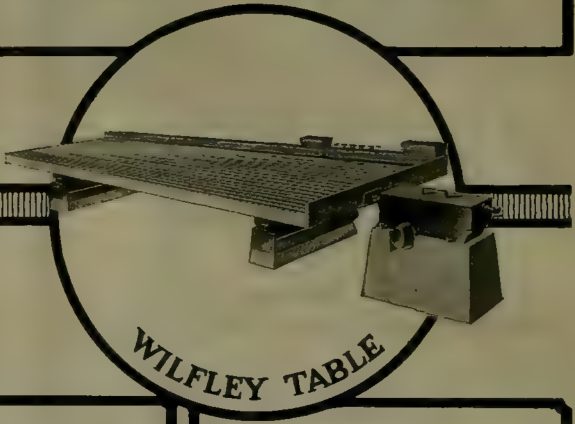

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EDITORIAL

T. A. RICKARD, ... Editor

IN the latest bulletin of the Institution of Mining and Metallurgy, in London, we read a description of the ceremony attending the unveiling of the war memorial to those members and associates of the Institution who died on active service. The list numbers 126 out of a membership of about 2000. The unveiling of the memorial by Field-Marshal Earl Haig was followed by a solemn silence of one minute, after which the Field-Marshal pronounced the words: "Their name liveth for evermore". The members of the British engineering profession responded nobly to the call of duty in behalf of the great cause that became ours also. Gentlemen, we join with you in standing silently at the salute!

THE dignity of Labor, with a capital L, shows itself in various forms, some of which indicate a lack of that priceless possession, a sense of humor. The manager of a gold mine in Victoria, Australia, recently suspected that all the precious metal produced was not finding its way into the coffers of the company; so at a pre-determined date the men from the mine were searched and their houses were raided for ill-gotten gains. The result was that about 15% of the miners were found with stolen specimens in their possession, and much gold was discovered in the houses near-by. Before the manager had time to do more than recover the purloined metal the men proclaimed a strike as a protest against the undignified treatment they had received. Such are conditions in Labor-ridden Australia.

WHAT the so-called premium on gold means to a big enterprise in South Africa is shown by the annual report of the New Modderfontein, the premier gold mine of the world. During the financial year ended June 30, 1921, the output was 1,083,000 tons yielding 9.741 dwt. per ton, or 527,477 ounces of fine gold. The extraction was 98%—a truly splendid metallurgical achievement. The gold was sold for 112.58 shillings per ounce, as against 102.25 shillings in the previous year, and as against the normal or pre-war price of 85 shillings per ounce. The working cost increased 1½ shillings per ton milled, and the yield decreased 0.58 dwt. per ton, yet the working profit for the year showed an increase of 7 pence per ton. But the most interesting feature of the report is the statement that "the total profit for the year was £1,720,202 17s.4d., of which £751,427 was obtained from the increased price of our product above standard price". Thus the discount on the paper pound, as measured in gold or in American dollars, brought an increase, in terms of paper currency, of 43% in the profit won by this gold-mining enterprise.

CARBIDE lamps have one shortcoming—the likelihood of the burner clogging at an inopportune time. Messrs. J. E. Turja and J. W. Jacobson, of Hancock, in Michigan, have patented a device that is said to prevent this clogging entirely. It seems ridiculously simple. A short wire housed in a curved brass tube is operated by a push-button conveniently placed on the top of the lamp, where it can be reached by the thumb of the hand carrying the lamp. The free end of the wire normally is held just behind the burner-tip by a spring beneath the button and within the tube, which is enlarged to accommodate it. When the button is pressed or turned, the wire pushes the particle of obstructing matter out of the tip, the lamp continuing to burn in the meantime. This is the way the device works in theory and, it is claimed, in practice. The common method of cleaning the burner is to put out the light and insert one of a bunch of small wires that the miner carries in a small tube in his pocket; necessarily this pushes the obstructing particle back into the burner, where it may cause trouble again. It is clear that a device of this kind, if practicable, will obviate at least one of the primary causes of the emphatic but genial profanity for which miners in general are notorious. Only those who work underground know the aggravation of being left in the dark.

HYDRO-ELECTRIC power development promises to be the outstanding feature of industrial progress during the next 25 years. This is the opinion of the Federal Power Commission, whose first annual report has just been issued. During the 16 months that followed the passage of the Federal Water Powers Act of 1920 no less than 185 applications for preliminary permits and 85 applications for licenses to develop water-power were filed with the Commissioner. The resources under consideration totaled 11,060,000 primary and 5,766,000 secondary horse-power; the consummation of all the projects would involve an expenditure of over two billion dollars. Among the plants that have been licensed and in connection with which the construction work is proceeding are two of over half a million horse-power apiece, for the Niagara Falls Power Company and for the Southern California Edison Company, one of 110,000 horse-power for the Alabama Power Company, and several of smaller capacities. The more extended application of electric power will involve an initial expenditure for metals that will do much to restore confidence in the mining industry.

WE have received several letters asking for a specific reference in our pages to the Government's call for the production of war minerals. It will be found on page 319 of our issue of March 9, 1918, where we quoted from a circular issued by the late Franklin K. Lane, then Secretary of the Interior. The call was to save the ships needed for war purposes, by producing the needed minerals at home and so decreasing the number of vessels occupied in the transport of minerals from foreign sources. The minerals specified by the Secretary of the Interior were manganese, flake graphite, tin, tungsten, antimony, pyrite, magnesite, potash, and nitrates. In our issue of December 29, 1917, on page 918, we discussed the production of war minerals and referred to the urgency of the national demand as indicated by the steps already taken by the Geological Survey and the Bureau of Mines, acting for the Government.

IN a letter from the secretary of an organization with which we happen to be out of sympathy, the writer states his inability to dissociate from himself personally the criticism that is aimed at his doings as an official. This is one of the misfortunes of an editor, who, of course, is impelled frequently to criticize public affairs with which his personal friends may be connected or identified. On the other hand, the editor learns early in his experience to accept criticisms of his editorial utterances without going on the war-path against those who utter them and send them for publication in the paper with which he is identified. Frankly, life would be impossible if all of us were to take umbrage every time a friend is in disagreement with us on matters of public interest. The test of real friendship is to be able to disagree without quarreling; indeed, part of the pleasure of life is the frank ventilation of ideas and the exchange of thought between men of different minds. At this beginning of a New Year we send greetings to those whom we may have annoyed, unavoidably and inadvertently, during 1921; we wish them good luck, and we hope that in 1922 we may find issues upon which they and we can unite for the good of the mining profession and the mining industry.

DENVER is the home of yet another process that claims to free gold and all other metals from gangue or vein-matter, a 100% extraction of all 'values' being assured. Several of our subscribers have requested enlightenment as to the details of operation of the Codding process, as it is called, which has received highly favorable mention in various publications. We learn that the invention does not necessitate the use of either heat or acid; the metals are not dissolved. The ore is first ground to the desired fineness, then placed in 'tanks' and agitated with water, "or with the natural products of the earth as the case requires. The agitation and the metals and the sulphides which comprise the ore make it a Chemical and Electrical Process. There is enough electricity generated to produce the chemical and physical change". These features, we learn, are all patented. "Should the ore carry only such values as are amenable to quicksilver amalgamation, the pulp is circulated from the agitating tank to a recently perfected amalgamator, in which the mass is permeated by gravity through a body of live quicksilver at the rate of 15 to 20 gallons per minute, or more, as desired." The interjected statistics of capacity are interesting but unconvincing. "As the metallic values are liberated from the gangue, they are trapped by the quicksilver, so that at the end of the run the tailings show entire absence of such values . . . Simple or complex ores of every nature which have been treated by this process, during a period of years, have yielded perfectly satisfactory results . . . The maximum expense per ton treated with the process will not exceed $1 for simple or refractory ores . . . The solution [sic] does not saturate itself in any degree, so obviously if any extraction can be obtained, it is only a matter of sufficient time to effect a 100% extraction." From the above it will be observed that a feature of the process appears to be the somewhat bewhiskered idea of passing gold-ore pulp upward through mercury. The mass, we learn, "is permeated by gravity". In view of the density of quicksilver we believe that 'levity' is meant; and we are inclined to view the somewhat extravagant claims made by the interested parties as arousing reactions that belong to the same category.

The New Year

Let the dead past bury its dead; never were we more willing to say farewell to the dying year and to welcome the new—which only goes to prove how blessedly short our memories are, for assuredly 1918 was better exchanged for 1919 than was 1921 for 1922. Be that as it may, we receive 1922 with a smile, believing confidently that better times are ahead. The past year has been marked by the collapse of the metal markets and the closing of the mines that are dependent upon those markets. The dawn of 1922 finds the metal markets strong and hopeful, and from widely separated mining districts comes the news of a resumption of active operations. Copper felt more severely than any other metal the effects of the after-the-war collapse, therefore the revival of the copper mines is the most significant of the good tidings. In this connection we quote a statement made at New York on December 23 by Mr. John D. Ryan, of the Anaconda mining company: "For more than eighteen months I have been pessimistic over the immediate outlook, but I have now changed my view considerably. Business in this country has changed materially. Copper consumption in America has been 50% better in the last quarter than it was in the first half of 1921, and it may surprise the public to learn that the copper consumption of the world today is equal to that of the best pre-war year, 1913. The outlook for 1922 is now very encouraging". Governor Harding of the Federal Reserve Board says, "the bells that ring in 1922 will usher in a new business revival that will develop in due course into a new era of prosperity for the United States''. If the country be prosperous the mining industry will flourish, for the use of metals is essential to comfort, transportation, and communication. What is more, we see signs of a general resumption of the demand for the metals that are produced in the United States; the atmosphere of the world has cleared; storm-clouds linger on the distant hills; but the wind of unrest is dying down, and the rain of trouble has ceased to rattle on the roof. A rainbow gives the promise of sunshine and peace; an air of hope, as of a a new dawn, braces our tired nerves. We face the future gladly. To those engaged in the mining and metallurgical industries we send greeting and extend the hand of fellowship. Gentlemen, good luck to you in 1922, and after!

Pasturage for Bulls

A few days ago Mr. Charles Butters was telling us about his plans for developing and equipping a promising mine, named the San Albino, in a remote part of Nicaragua. After describing the proposed plant, he stated that the scale of operations depended upon ''pasturage for bulls''. In reply to questions he explained that the haulage of supplies and machinery was done by ox-teams and that they could not carry their own fodder, so that provision for grazing had to be made at the mine. In short, the scale and character of the mining and metallurgical operations had to be adapted to local conditions, or, to generalize, the strength of an industrial chain is measured by that of the weakest link. We are reminded of the experience of the Burma Corporation, which planned an industrial expansion on a large scale without paying sufficient attention to a basic factor, namely, an adequate supply of labor. Lacking that prerequisite the magnitude of the scheme of technical development had to be reduced. The economic limit of operations was fixed by the amount of labor available in the locality. That was their ''pasturage for bulls''.

Again, we recall the fact that thirty years ago a 40-stamp mill was regarded as the most satisfactory unit for that kind of metallurgical plant. It was the size that conduced to economical operation because it required no more and no less labor and supervision than was within the capacity of a complete crew and a competent superintendent. Any enlargement of the plant entailed additions to the force; any diminution permitted no decrease. Besides, the risk from fire was such that a 40-stamp mill was enough to put under one roof; it was deemed wise to divide 80 stamps under two housings. In later years, owing to the further development of labor-saving devices and the growing scale of mining operations, it was found that the size of the economic unit could be enlarged advantageously to 150 stamps. Meanwhile fireproof construction had decreased the risk of a conflagration. It matters not for the purpose of the present discussion whether 40 stamps or 150, or even 300, be the best unit; the point we are making is that there is a limit beyond which mere size or capacity does not connote effectual operation. This holds for the mine as well; a mine can produce enough ore, for example, to supply a mill of given size; beyond that tonnage it becomes necessary to trespass upon the ore-reserve or to lower the grade by including waste. Somewhere in the economic prevision or calculation there is a critical point, typified by the ''pasturage for bulls''. For example, a few years ago the gentlemen who controlled the mining industry of the Rand thought it clever to form a number of big consolidations. The mining companies operating at Johannesburg, but directed from London, were large enterprises already; they owned extensive areas of ore-bearing ground and they were working on a scale that already taxed the resources of their managers. However, it was decided to consolidate or agglomerate groups of five or six of the large mining companies into several super-enterprises. This enabled the controlling financiers to unite some languishing company owning a decadent mine to two or three strong companies owning highly productive properties; in other words, a weak sister was partnered with sundry strong brothers; a lame duck was made to flock with several golden geese; a mistake was covered and a failure was redeemed, at the expense of the public, which passively accepted the consolidation under cover of alluring assurances that the combination of companies would create an investment exactly suited to the trust-funds of widows and orphans, and to the taste of sundry simple-minded people needing gilt-edged security. The idea was that a gilt-edged investment could be made by combining a number of speculative ventures, the risk inherent in any one enterprise being decreased by spreading it among a number of similar enterprises. This financial philosophy might have proved sound if only the promoters had not ignored the impoverishment of the ore in depth. Some of them were aware of the impoverishment because their engineers had told them of it, but a tacit agreement for silence on this critical factor led to the transfer of millions of pounds—not dollars—from the pockets of the many to the coffers of the few. The non-persistence of the ore (using that term in its economic sense) in the mines of the Central Rand was the 'pasturage for bulls' of the flamboyant calculations that bemused London ten years ago. In one sense the pasturage for 'bulls' on the Stock Exchange was more than ample for a while, the shares being pushed to quotations far beyond their intrinsic value, but in the end the pasturage became overgrown with bushes of bitter berries on which the 'bears' feasted rapturously. The fashion for big holding companies, such as the Consolidated Gold Fields of South Africa and the Rand Mines, Ltd., led to the promotion of undertakings to which the public was persuaded to accord the character of a financial trust, so safe as to be attractive at a return so small as to argue an 'investment', not a speculation. The market-value of these big consolidations has depreciated pitifully; they are a fiasco and a fizzle partly because in their manifold operations they transcended the scope of personal management. After all, a man's capacity for supervision is limited. The individual mine and the separate enterprise in South Africa, as elsewhere, was already large enough to occupy the entire time and to consume the whole energies of a resourceful manager, that is, he had as much as he could do to inform himself concerning the progress of operations and to keep in touch with developments from day to day, so as to direct them intelligently and efficiently. Any expansion rendered it necessary for him to deputize his duties and to transfer responsibility to assistants. In this issue we publish a humorous article by Mr. C. T. Hutchinson in which he pokes fun at the modern habit of enlarging and expanding industrial enterprises to the point of disintegration. When an enterprise is so vast that the controlling mind cannot cope with the duties involved—and it must be one mind, not many—it becomes the victim of its own bigness. Instead of being held and directed by the reins of an individual of distinct character and recognized responsibility it is tied to the loose ends of a vast departmental system the chief prerogative of which is 'to pass the buck'. This shifting of responsibility is demoralizing; so is the inevitable effort of each department to justify itself by aggrandizing its scope and importance at the expense of the others. Solidarity is as necessary in large mining and metallurgical enterprises as was the pasturage for bulls at San Albino. To take another concrete example: a big mining and smelting company starts to operate a mine far from the seat of its major operations in order to secure a particular kind of ore for its smelter. It avails itself of its technical staff and sends one technician after another to this mine for the purpose of making investigations, to be followed by suggestions for changes in plant and practice. Much of this is advantageous to the mine in question, but not all of it; meanwhile the smaller undertaking is saddled with a large overhead expense; it calls away from their regular duties the members of the staff of the parent enterprise, not without harm to the principal operations. It were better to operate the small mine as a separate unit. As one more illustration we mention the fact that during the closing days of 1921 the financial press of New York repeated sundry rumors of big mergers of copper companies. It was said that the American Smelting & Refining Company is to combine with the Utah, Braden, Chile, and Kennecott companies, thereby creating an enormous copper-producing enterprise. If the purpose be to make an organization for the joint marketing of the copper, we can understand the advantages that may accrue, but if it be for the purpose of placing one or more weak or decadent undertakings under the cloak of consolidation, we trust that the intention will be abandoned. The American Smelting company already has exceeded the capacity of those in control, more particularly its president; it is by no means unique in this respect, for few indeed are the big consolidations that have justified themselves in efficiency or service, much as they may have provided pasturage for the bulls on Wall Street. They have over-extended the abilities of their directing minds and have served mainly to stifle the legitimate competition that is essential to the proper discipline of a public corporation. Another rumor hinted that the Anaconda company is to absorb the Inspiration, Calumet & Arizona, and other mining companies in the South-West. It is true the Anaconda in the recent past has won a reputation for good management, but we venture to suggest that it also has spread its activities far enough. Even in Montana the operations of the Anaconda are so diverse and so scattered as to tax adequate supervision and co-ordinated control; but the Anaconda has copper mines in South America, such as those operated by the Andes and Santiago companies. We can see no gain to anybody, either the shareholders or the public, in the proposed merger, the report of which we hope may prove a canard. On the other hand, the absorption of the American Brass Company by the Anaconda company, as recorded in these pages last week, is an entirely different matter, because it is perfectly logical for a mining and smelting company producing large quantities of copper and zinc to secure a means of fabricating and selling brass products.

Swollen consolidations have another defect, and that is the destruction of character. Their overgrowth of expansion weakens the morale of the administration by substituting divided control for personal direction; it lowers the morality of those responsible by adding to their number. A board of directors usually has less sense of right than the average member of the board; sometimes its morality is that of the least moral of those present; in any event, it is characteristic of boards and committees to pass the buck morally as it is the fashion among the departments of a big organization to shelve responsibilities when they prove inconvenient. This striving for mere bigness is the curse of the modern world and the bane of honest industry; it is based on shallow thinking; it exceeds the known limits of human capacity; its fatal defect is the failure to provide "pasturage for bulls".

Insurance of Employees

In the annual report of the Department of Mines and Industries of South Africa, the Government Mining Engineer, Sir Robert N. Kotzé, comments on the need for anticipating and preparing for unemployment and distress that may result from occasional or periodic interruptions to industrial progress, with particular reference to diamond mining. As is well known, toward the end of 1920 there was a complete collapse of this important branch of South African industry, resulting in the closing-down of most of the mines and a restriction of work of others. Although the diamond-selling syndicate maintained at normal the price of stones that were sold, the market-value outside its sphere of influence was greatly affected. Prospecting for diamantiferous ground almost ceased. Large numbers of men were discharged from the mines, and swelled the ranks of the unemployed. In some cases the companies endeavored to mitigate hardship by grants and bonuses, but this only partly relieved the conditions. The general impression seems to be that an industry should be able to cope with the unemployment resulting from slumps such as have occurred during recent times; the country as a whole should not be called upon to apply a remedy. It may be contended, says the report, that the mine-owner suffers with the worker, but this is not entirely true, for he can or should make provision for a rainy day by conserving part of the dividends received during years of prosperity. It is also patent that the probability of an occasional industrial collapse has the tendency to prevent an undue appreciation of the value of stocks and shares during normal times; this is to the benefit of the purchaser of such a form of investment. For example, De Beers Preferred shares are now quoted at about £10. Since 1905, the average dividend has been £1 1s. 5d. per share, or 10.7% of £10; but for four years no dividend was paid, and the average dividend for the remaining 12 years was at the rate of 14.3% of £10. During the past few years the dividends have been at an even more substantial rate. It is clear, says Sir Robert, that the tendency is to take into account the probability that there will be years in which dividends will diminish or disappear; the value of shares is not based entirely on the fact that dividends have been paid in the past. On the other hand, during prosperous times the worker is not paid a proportionately higher wage out of which he can build a reserve fund in anticipation of the days when a falling market may lead to unemployment. We are inclined to agree that it is not unreasonable to argue that his sense of security should be considered by his employer, preferably by the provision of an insurance fund, from which an allowance can be paid to him during periods of economic depression or when other occasion demands. There is much to be said in favor of the contention that such a method would alleviate some of the distress that results from unemployment. If the State were obliged to make the outlay, it is probable that it would recoup itself, in part at least, from the profits of the industry in question. The subject is one of interest; it supports the contention that men as well as machines represent capital expenditure, and that allowance for amortization and depreciation, as well as for interest, should be provided.

The Use of Metals

At a time when mining is just emerging from a period of acute depression, from a malaise the chief symptom of which is unreasoning pessimism, it may be desirable to remind ourselves of the extent to which the use of metals enters into our daily life. Most of us begin the day by arising from a bedstead made of brass, which is an alloy of copper and zinc. Our movements are aided by steel bed-springs. As we go to the bath we open a door by means of a brass knob—more copper and zinc. Inside the bath-room we are sorrounded by evidences of the fact that our comfort is dependent largely upon the service of metals. The word 'plumbing' signifies the use of lead, for *plumbum* is the Latin for lead, and its abbreviation, Pb, is the chemical symbol of that modest metal. The fixtures are nickel-plated, that is, either brass, cast-iron, or wrought-iron coated with nickel, to prevent rusting. The bath-tub usually is made of sheet-iron coated with an enamel that itself is the product of mining operations; for it is a vitrified form of clay. Returning to the bedroom, we see a pin on the floor and pick it up. Most pins are made of tinned brass, but the cheaper kinds consist of tin-plated steel wire. A mere man hardly realizes how great is the consumption of pins, except when he buys a shirt or prepares to wear one that has come from the laundry; but to womankind the pin is the prime implement of their engineering; their idea of chaos, we are told, is "at inconvenient moments to come undone". It is estimated that 10,875,000,000 pins were used in the United States in 1918. More than half of the factories established for the purpose are in Connecticut. Let us suppose that we are now ready for breakfast, having shaved with a steel razor by the aid of soap in a nickel-plated container. We go downstairs, passing over brass rods on the stairway and opening more doors with brass knobs. In the dining-room we find metals galore. On the table shines the silverware that kind friends gave us when we were married. The spoons and forks are of silver, alloyed with a little copper to harden the metal. The knives are made of steel or of silver-plated steel. The big tray is Sheffield ware, which is silver-plated copper. In the corner stands a lamp on a bronze pedestal. Bronze is an alloy of tin and copper. The light comes from a tungsten filament heated by the energy transmitted along a copper wire. The various fixtures are made either of brass, bronze, or nickel-plate, which together involve the use of copper, zinc, tin, nickel, and iron. A brass fender lies in front of the fire-place, and leaning against it are tongs and poker made of brass and iron. The comfort of the breakfast-table is aided by an electrical toaster, the coils in which may be made of german silver, an alloy of copper, zinc, and nickel. Afterward, if our observer happens to be the lady of the house, she will go into the kitchen to consult the cook. There she sees metal on every side. The stove is made of iron, with nickel and enamel accessories. The pots and pans are made of tin-plated iron, enameled iron, copper, or aluminum. The glint of a copper kettle suggests cleanliness. Nickel-plated utensils are numerous. The plumbing bespeaks lead again. A well-ordered kitchen is scrupulously clean and is painted at frequent intervals. The white paint is made either of lead oxide or zinc oxide; its ingredients are produced from the ores of zinc and lead. That reminds us that paint is used all over a house, especially on the roof, the various pigments being derived from metallic ores. The roof itself may consist of metal—copper, zinc, or various kinds of sheet-iron in the form of shingles or tiles. On the windows are brass rods and under the tables and heavy chairs are castors, made of soft iron and brass. The electric heater has a nickel-plated base and a copper reflector. Bronze and brass are to be seen in numerous ornaments and fixtures. Silver and gold will be found in sundry treasured possessions.

It is now time to go to the office. At this season of the year we carry a steel-ribbed umbrella, which, if a gift, is likely to show metals more precious than iron. The automobile is made of various steel alloys containing such metals as manganese, chrome, magnesium, tungsten, vanadium, and molybdenum, besides copper and aluminum. The interor of the car may show brass, bronze, or nickel-plate. The buttons on the upholstery are made of lead. The rubber of the tires is prepared with zinc oxide. Copper wires are used for electric transmission both in the starting apparatus and for lighting and ignition. The suburban train exhibits the use of metals in many forms, from the copper wire that brings the electric energy, to the steel rails on which the train runs. Inside the car are fixtures made of various metals. Arriving at the terminal, our observer walks to his office and nearly stubs his toe against a galvanized-iron can for rejected newspapers—and in San Francisco such a container is a prime requisite. In his office he finds that his telephone receiver shows brass and nickel-plate; his filing-cases are made of steel; so is his pen. Paper-clips of nickel-plated brass or iron are on his desk; his inkstand is made of brass; his swivel chair moves on a steel pivot. We might proceed to mention such details as the steel eyelets in our shoes and the silver buckles that support sundry garments, the gold watch and the steel pocket-knife, but to continue the catalogue would be tiresome. Each reader can add to the list. When he has done so, he will have fulfilled our purpose, which is to remind him that the material basis of our civilization is metallic, and therefore that the mining industry is essential to modern life.

Methods of an Uncamouflaged Trust

Details of a real and honest-to-goodness trust, which controls effectively the output and the price of a commodity throughout almost the whole of the civilized world, are given in a recent issue of 'Commerce Reports'; we refer to the iodine producers' association of Chile. As a preliminary, it is necessary to correct a general misapprehension, encouraged by the misstatements of a large number of writers on chemistry, especially those whose books are of the popular type, that iodine is recovered mainly from seaweed. Such is far from being the case; all the iodine consumed in this country is a by-product of the mining industry, being recovered from the *agua vieja* or mother liquor that results from the treatment of Chilean caliche. The imports of the element into this country from Chile amounted to 1,254,011 pounds in 1919, valued, according to 'Mineral Industry', at $2,395,969; during 1920 the imports amounted to 293,941 pounds, valued at $593,672. The Combinacion de Yodo, as the iodine trust is called, has its headquarters at Iquique; it originated by virtue of a public deed in 1894; its activities have been extended at intervals, as required by the articles of association. The combine is controlled by a set of drastic by-laws, the objects of the association, as set forth in these, being as follows: (1) To regulate the export of iodine; (2) to regulate the distribution of the quota of each associate in the sales of the combination; (3) to arrange for the sales of the iodine belonging to the associates, and for that purpose to enter into consignment contracts; (4) to enter into an agreement with producers of iodine for the sale and for the supply of the amounts needed to meet consumption, through the instrumentality of agents appointed for that purpose or in any other way that may be found convenient; (5) to bring about in every possible way the consolidation of the combination, procuring the adhesion of new producers; and especially (6) to secure an increase in the consumption of iodine by means of propaganda, by offering rewards for the best studies suggesting new uses for iodine, or to inventors or to those who discover some new application for this article. Every nitrate establishment belonging to an associate of the combination and actually manufacturing nitrate has the right, even if not equipped for the manufacture of iodine, to a quota in the monthly sales. This quota is determined in a manner prescribed in the statutes, each producer having the privilege of selecting either of the two following methods of computation: (*a*) by actual trial of the capacity of the establishment to produce iodine under specified conditions for a period of 30 days, or (*b*) by the decision of experts. The statutes also give the combination the power to enter into a contract with a European firm, for periods not exceeding five years, for the consignment and distribution of iodine, on the basis of 5% commission on sales. One of the articles provides that the associated manufacturers shall pay a contribution not exceeding five shillings per quintal of iodine sold, to cover the cost of administration; this will be collected from the associates according to the monthly quota of each; to increase or to decrease the contribution requires the assent of 80% of the members. Another article of association provides for the establishment in London of a consultative body, known as the Iodine Sub-Committee. Five of the six members of this sub-committee must be persons that are interested in the nitrate industry, are members of the iodine combination, or are the directors or legal representatives of nitrate companies associated in the combination; the sixth must be a representative of the consignees. Members of the trust are prohibited from making, exporting, selling, transferring, or "otherwise negotiating" iodine, either in Chile or in any other country, except as laid down in the by-laws. The Combinacion de Yodo is essentially a group the purpose of which is to control prices and restrict production. Only a small proportion of the iodine in Chilean caliche is recovered; the remainder is deliberately wasted. An American operator who decided to manufacture iodine in Chile and to sell it outside the trust would find himself *persona non grata*, and to an extent that would interfere with his continuance in legitimate business. If he returned to the United States to make iodine from our own resources, his product would be underbid by the imported article. There is no question of the cost of labor here as compared with the cost in Chile; the receipts to the nitrate operator from the sale of iodine constitute what is known locally as a *llapa*, which, by interpretation, means a gratuity.

Relation of Mining to the Development of the State

By L. D. Ricketts

*Statistics are tiresome things. I have often heard it said, if you are rash enough to introduce figures into an address you kill its effect. At the same time I do not know how I can speak on the relation of mining to the development of the State without quoting some figures, but I shall be as brief as I can.

I came to live in Arizona in 1890. My one regret is that I did not come earlier, for I have loved my life in Arizona. The mining camps at Clifton, Globe, Bisbee, and Jerome were already producing copper, some of them at a profit. Irrigation was well under way, chiefly in the Salt River valley and in the valley of the Gila about Solomonville. Two main lines of railway crossed the State, largely because Arizona happened to be in the way of getting from the East to California, and there were a few branch lines. Grazing was pretty well established. Miscellaneous business in the State was limited in volume. Since that time all of the chief industries of the State have advanced in a most remarkable way.

In 1890 the population of Arizona, exclusive of Indians, was 58,000. In 1920 it was 301,000, an increase of 420%.

In 1890 the copper production of Arizona was 35 million pounds. In 1920 it was 553 million pounds, or an increase of 1500%.

In 1890 the acreage under irrigation was in round figures 66,000. In 1920 it was 467,000, or an increase of 600%.

In 1890 there were about 1025 miles of railway in the State; and in 1920 there were 2477 miles, or an increase of 145%. It should be remembered that the railroads built prior to 1890 were meant largely for transcontinental business. Since that date almost all the extensions of railways have been for the development of local State traffic and no new transcontinental line has been built.

In 1890 mining and metallurgical processes were most imperfect, the appliances for handling material were crude and inadequate. For such reasons the output of a man per day was exceedingly limited and it required ores containing 15% copper, which even then were becoming exhausted, to produce the metal on a profitable basis. In order to meet the increasing demand for copper, methods had to be devised to treat leaner ores in the existing mines and to make new mines out of the great outcrops of copper-bearing material that had long been known in the State, but which did not contain material that could be worked at a profit at that time.

The miner and the metallurgist attacked these great problems with splendid courage and pluck, and their efforts met with great success. In 1890 only tiny blast-furnaces were in use in Arizona. Most of the mines smelted oxidized ores with great losses of copper. Jerome alone produced matte, but this had to be hauled over a great mountain range to Prescott and then shipped to Baltimore for further treatment.

The first great advance was made by Dr. Douglas in 1894 when he introduced at Bisbee the trough-converter, which was then in successful use at Butte. This enabled him to smelt his own sulphide ores to a matte with a much higher recovery of copper and with a much lower consumption of coke. About the same time Clifton began to construct small and crude concentrators, which later on were enlarged and greatly improved. In 1898 all-steel construction was introduced in new smelters and concentrators in Arizona, and another great step was the introduction of the belt-conveyor for the local transportation of ore. In 1903 the Copper Queen introduced the large blast-furnace, electric haulage, mechanical feeding, and large slag-cars in the Copper Queen plant at Douglas. This was followed at Cananea in 1906 by the successful introduction of the reverberatory furnace, and the Arizona smelters rapidly followed suit—in some cases entirely supplanting the blast-furnace with reverberatories. In 1912-'13 experiments at Inspiration proved that flotation was applicable to many copper ores, and then came the development of new chemical methods for the treatment of oxidized copper ores with the successful introduction of acid leaching and electrolytic recovery of copper from solution in the great mine at Ajo.

While this rapid progress was being made in metallurgy there was for a time less progress made in the mining methods, because the problem here was much more difficult. The first great advance was made by Louis S. Cates who developed in Utah and introduced at Ray his shrinkage system with such intelligence and success. His method has been extended to other districts. Later the so-called Ohio system, developed by Felix McDonald in Utah, was adopted at Inspiration and Mr. McDonald was employed to supervise it there.

In 1890 I estimate about 140,000 tons of ore was treated with a yield of possibly 250 pounds of copper to the ton, and a production of 35 million pounds of copper. In 1920 I believe over 100 times the tonnage of ores was treated with a yield of not to exceed 30 pounds of copper, and this has been rendered possible through increases in the size of units, through great and radical improvements in processes and methods, and by the introduction of mechanical appliances for handling material in mines and smelters.

It is these points that I wish to lay stress upon. In the early days we were only able to work rich ore because our methods were crude and our appliances inadequate and small. Through the improvements in process that I have

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*An address delivered on December 15 at Phoenix before the Arizona State Industrial Conference.

mentioned, and through the wonderful revolution in the methods of handling material, we have been able to employ labor at higher rates, to meet the increased demands for labor from other industries, and to decrease the use of it to a large extent. We have economized in labor and supplies. The efficiency of a man-day is tremendously increased, and it is for these reasons that the copper industry of Arizona exists today.

In 1890 the output of ore per man-day was certainly less than a ton. Today I have not the data for an accurate statement, but I believe the output per man-day is probably ten times as great.

I now come to the relation of this growth to the general prosperity of the State. As I have said, in 1920 our copper output was 553 million pounds. During the current year we were feeling the beginning of the panic and the output was over 20% less than in 1917. I have no doubt that if there were the demand and copper mining were profitable Arizona could equal the figures of 1917, when the output was about 720 million pounds, and I have had collected for that year statistics showing expenditures of all the mines for certain of the major items. I have had furnished me the actual figures from all the important mines of the State but one, and of all the important smelters of the State but one, and on these I have had to make an estimate of expenditures; I have been conservative, and the expenditures I have estimated on behalf of this one mine and smelter are below the average of the remaining mines and smelters of the State, and any element of error is, I am sure, small and on the safe side. My estimate shows that, exclusive of salaries paid from New York, which are comparatively unimportant, and New York office expense, selling expense, interest charges, etc., the following sums of money were spent strictly by Arizona mines. I avoid fractions and give the figures in the nearest thousand:

For labor	$34,299,000
For freight	17,786,000
For refining	5,033,000
For supplies at their source, including fuel-oil, coke, etc., and taxes	26,055,000
A total of	$83,173,000

As I have said, New York charges are not included in the above, but we have in these figures I have given a cost of 11.5c. per pound. Now of this cost, how much was spent in Arizona? I estimate that about 50% of the freight is allotted in divisions to railroads in Arizona, including main lines and their branches. This may seem high, but it should be remembered that in that year our fuel-oil originated at Segundo, our lumber at San Pedro, and there was a large movement of strictly intra-state tonnages, including the ores between Bisbee and Douglas and Ray and Hayden. I assume 70% of the rates for operating expenses. If this is the case, of the above 83 million dollars between 47 and 48 millions in actual gold coin were paid out in Arizona, and of this over 40 millions consisted of payroll and taxes alone. I have not included anything whatever for the purchase of mine supplies within the State, although the farmer and timbermen know they are considerable, nor have I included sales to employees of any kind.

When we come to 1920, the production has dropped over 20%, but labor in 1920 was higher than in 1917; freight was tremendously higher; refining and taxes were higher. While therefore the output of copper in 1920 was about 553 million pounds, the amount of money spent was about the same. Labor was about 5 millions less, or about 29 millions instead of 34 millions. Refining was much more, and supplies, taxes, etc., much more. I estimate the cost of the items as enumerated for the year 1917, without New York office expense, was a little over 83 million dollars, or nearly 15c. per pound of copper.

Remember, these costs do not include the Eastern office expenses. They include nothing for interest charges, for depreciation, or for the exhaustion of the mines. Since April of this year scarcely a mine has operated. Still the money spent by the mines during this year is considerable. In the Warren district alone I presume half a million dollars a month is being expended, and throughout the State possibly quadruple this sum.

As you know, at the beginning of the year 1920 there was a large surplus of copper that had been nominally quoted at a high price, but could not be sold. At the end of the year still more copper was on hand. The surplus increased enormously and finally in April of this year the mines had all of their money locked up in copper and the copper could not be sold and we had to face a crisis and cease production; and you know what has happened since. A large part of the copper has now been sold, but it has been sold at prices varying between 11c. and 13c. per pound. The copper mines generally have acted in a conservative way. They will have a cash surplus and will be abundantly able to resume operations when the time comes to do so, but they have made a loss on the copper that they produced and had to sell at a sacrifice.

This covers the substance of my address. I have given you some facts. It is with some hesitancy that I make a few remarks as to probabilities in the future. I have given you the facts as they stand. I am not pessimistic. We can and will economize, and while it may be that all of the mines cannot resume at present prices, I believe at least by next spring some of the mines will be in operation, and I believe with care and economy that we can operate under the prices that prevail. I believe that the copper business of this State is going to be just as successful in the long run in the future as it has been in the past; and as I believe in copper, so do I believe in our other industries. All I have to say is that we must all work; we must all pull together; there can be no question of our gradually forging ahead with gradually increasing speed.

We are confronted with two serious difficulties. One, and the less important one, is excessive freight-rates. We must remember that it is perfectly natural that the railways should wish to maintain as high rates as possible because of their shareholders and employees; but if the rates are maintained, it will mean a curtailment of copper output. A great deal of our ore that should be profitable will become unprofitable and the tonnage of profitable ore in sight will be decreased. I believe that it is up to the shippers to show the railroads that rates should be materially reduced, and I believe that they will be reduced.

The other and much more serious question is that of fuel. Several years ago when the mining companies requested bids from California we were told by the large producers that they had no fuel-oil for sale, but we were fortunate enough to make an advantageous contract for Mexican oil. I believe it is only a question now of a few years when this commodity will become so costly that we cannot afford to use it. We probably can get an inferior coal at high cost that will be sufficient for smelting purposes, but I hope we will not be obliged to use this coal for power.

I have had the subject of power carefully canvassed. I find that the mines and smelters of the South-West, including northern Sonora, now use about 70,000 hp. in addition to the power they recover from waste heat, and my report shows that it is probable this demand will increase to over 100,000 hp. in the next four or five years. I wish most urgently to bring to your attention the fact that Arizona needs cheap power and is faced with the most serious menace if it does not get it, and the only source of cheap power that I know is the Colorado river. It is a matter of indifference to me who develops this power, but I believe its immediate development is vital to the best interests of the State. I may further say, if fuel-oil is not available and if cheap power can be obtained in Arizona, I believe there will be an extension of leaching in contradistinction to smelting, and that the refining industry and the production of electrolytic copper in Arizona will become a great and important industry. I have today able chemists at work trying to devise methods of leaching certain classes of mixed and sulphide ores in order to provide in the future for contingencies of which I speak.

STATISTICS of output in Belgium's main iron and steel branches from April through September make it appear that the low point in production was reached in July, since which time practically every division, with the exception of pig-iron, has shown an advance, states a consular report. It is, in fact, reported that three additional blast-furnaces are about to be re-lighted. The September production of pig-iron was only 19% of the monthly average for 1913 (207,058 metric tons) and 43% of the 1920 average (93,033 metric tons). Similarly, the production of raw steel was only 15% of the 1913 average and 31% of the mean monthly figure for 1920; and that of rough castings 60% of both the 1913 and the 1920 monthly average, current production of rough castings having approximately reached the 1913 level. Spelter production has shown a shade of betterment since June, but not enough to justify any sanguine hopes of a resumption of business. Tonnage figures for the last six months are: April, 4320; May, 4360; June, 4370; July, 4950; August, 5000; and September, 4990. Spelter prices until July remained steady at 145 fr. per 100 kilos, and then declined in August to 130 fr.; present quotations are 150 fr., with a decidedly improved demand, which is also reflected in the improvement of quotations on rolled zinc (172.50 fr. per 100 kilos) and corrugated sheets (177.50 francs).

THE geology of eastern Oregon can be summarized by stating that nearly the whole of that portion of the State is underlain by Tertiary lavas, states a bulletin of the Oregon Bureau of Mines and Geology. Relatively small areas of Cretaceous and older strata occur in the Blue mountains; Tertiary freshwater sedimentary strata, commonly more or less ashy in composition, overlie or locally underlie the lavas and form the surface formations in scattered areas. Tertiary strata of freshwater origin but chiefly non-tuffaceous in character and of great thickness occupy the valleys of Snake river and tributary streams in the Vale and Ontario region. Drilling for oil and gas has been done or is now being carried on in the Dalles region, west of Dufur, south of Burns, south of Klamath Falls and east of that city, and around Vale and Ontario. All the wells have gone down in Tertiary sediments. Many of them have struck small quantities of gas; some, such as the Boyer well in Ontario, have encountered considerable quantities at high pressure which, however, decreased rapidly. Traces of oil have also been reported in a number of these wells but no verifiable cases in which a notable quantity of crude petroleum was brought to the surface were discovered. Many reported seeps of oil were investigated, but no true seeps were found; the reported oil-colors in every case turned out to be iron films. As to prospects for oil in commercial amounts, eastern Oregon cannot be regarded as impossible territory, but it is rather improbable territory. This judgment is based on the absence so far as known of typical oil seeps, the freshwater origin of all the sedimentary strata except those in relatively small areas in the Blue mountains, the scarcity of the mother rocks of petroleum, the dominantly volcanic nature of the rocks underlying the sediments, and the failures to date. The chances of securing oil in the relatively small areas of considerably deformed marine strata in the Blue mountains cannot be appraised accurately on the basis of the brief examination made of them. An oil supply is probably not to be expected in them. The possibility of a commercial gas supply is somewhat better; considerable drilling has thus far encountered, however, only one or two bodies of gas which in quantity approached a commercial supply. Gas occurs in small amounts at many points in the Tertiary strata, but it would appear that the thick sections in the Ontario-Vale region afford the best chances of encountering a commercial supply. It is to be recognized that even here, however, the likelihood of developing a large output does not seem good. In drilling test-holes in this region locations should be chosen on folds at some distance from the higher hills that surround the district. This is advisable, inasmuch as these hills are composed mainly of igneous rocks, and because the thickest sections of strata undoubtedly lie in general in the middle parts of the valleys.

Mining in British Columbia in 1921

By H. Mortimer-Lamb

In common with other mining countries, British Columbia has been affected adversely during the past year by the fall in the prices of the base metals, copper, zinc, and lead, consequent on the steady accumulation of stocks, in particular since the close of the War, and of the general depression in trade during the past two years. Copper's decline from an average market price of 17.45c. in 1920 to an average price of 12.41c. in 1921 means, roughly, a depreciation in marketable value of 29%. In the case of lead, the average price in 1920 was 7.96c., and in 1921, 4.53c., or a decrease in market value of 43%. The price of zinc fell from the average of 7.67c. in 1920, to 4.62c. in 1921, or a decline of nearly 40%. No less marked has been the decline, equivalent to 37%, in the price of silver; and as, in British Columbia, this metal is produced mainly in connection with the mining of lead and copper, the effect of its depreciated value has been doubly inauspicious. In brief, it may be affirmed that such metal-mining operations as have been conducted during the past year have afforded but a narrow margin of profit; in certain instances they have been conducted at a heavy loss. Two companies only have carried on continuous large-scale metal-mining operations during the year. These were the Consolidated Mining & Smelting Co. of Canada, operating the Sullivan zinc-lead mine in East Kootenay and copper-gold mines in Rossland, and the Granby Consolidated Mining, Smelting & Power Co., operating copper mines at Anyox. To their activities may be attributed the fact that the metalliferous output for the year, in point of quantity, has been maintained at a level not pronouncedly below that of last year; indeed, there has been an actual gain in the production of lead and zinc. Measured however in terms of value, the production of silver, copper, lead, and zinc, it is estimated, will not be much more than half that of 1920. In other words, instead of a production of these metals valued at nearly $19,750,000, this year's output will not have a valuation much in excess of $11,000,000. In 1920 the returns in respect of gold, from both placer and gold mining, gave a valuation in round figures of $2,700,000. The yield in 1921 probably will be rather less. Coal and coke production is estimated to have been, this year, about 85% of that of 1920; and generally speaking it may be added that the coal-mining industry of the Province has been on a rather more satisfactory basis than that of any other class of mining, notwithstanding the fact that wages remain high and there are other conditions militating against the expansion of the industry. Of these conditions on the Coast the most formidable is the competition with which operators are confronted by reason of the importation of fuel-oil from California to replace coal for use both on railways and in factories. It is estimated, for example, that last year the consumption in British Columbia of fuel-oil was over 4,000,000 barrels, valued at $12,000,000, to the displacement of 1,200,000 tons of coal. The imported fuel-oil is merely a residuum or by-product from the Californian wells, the valuable gasoline content having first been extracted. Therefore it can be sold at a low price; but having regard, as surely we should, to the more important consideration of the prosperity of our own industries, shared as this prosperity must be by the community as a whole, such advantages as the users of imported fuel-oil may derive might well be discounted, and a whole-hearted support given to the proposal that the duty on this foreign product be increased sufficiently to afford the coal mines of Vancouver Island the measure of protection that would enable them to combat successfully competition from this source. The disastrous effects on the coal industry consequent on the use of fuel-oil is emphasized by the statement that the present annual production of the Vancouver Island mines is nearly half a million tons less than it was ten years ago.

In conclusion, an optimistic note may be sounded. Undoubtedly the clouds are dispersing, if slowly, and brighter days are again dawning for the mining industry. World events are so shaping as to indicate an earlier readjustment of the complex and difficult post-war problems of international commercial relationships than even the most sanguine had been inclined to expect. There must necessarily follow in due course a normal resumption of trade. The demand in Europe for metals has in no way diminished; it is now probably greater than ever before, and self-interest impels those capable of satisfying that demand to find a way of removing the present obstacles to the marketing of their products in foreign countries. Both at home and abroad there is less of unrest, and a gradual but notable restoration of confidence in the stability of the existing order; and with the rapid decline in basic costs of production, industry will once again be afforded reasonable opportunity to prosper.

In the Province of Quebec, Canada, there are six main centres of production of asbestos, and these localities in 1920 yielded nearly 180,000 tons of asbestos fibre, as compared with about 24,000 tons produced by all the other countries of the world, states a bulletin of the Department of Colonization, Mines and Fisheries. Of these six centres five are situated on the line of the Quebec Central railway, which connects Quebec with Sherbrooke, a distance of 143 miles. These five centres are East Broughton, 60 miles south to Quebec; Robertson, 71 miles; Thetford, 76 miles; Black Lake, 80 miles; Coleraine, 86 miles. For the distance of 26 miles between Coleraine and East Broughton the railway follows the general trend of the serpentine belt, most of the principal mines being situated within a few hundred feet of the main line; the asbestos deposits are therefore almost equidistant from Sherbrooke and from Quebec. At Sherbrooke the railway connects with the railroad system of the United States, and at Quebec is situated a harbor open to the largest ships during seven or eight months of the year. The sixth centre is near Danville, 80 miles south-west of Quebec, and 30 miles from Sherbrooke.

The California Rand Silver Mine—III

Metallurgy—Concentration by Flotation

By Arthur B. Parsons

The gross value of the gold and silver contained in the ore shipped by the California Rand company since June 1919, when the first consignment of 55.9 tons was sent to the Selby smelter of the American Smelters Securities Co. on San Francisco bay, is $2,878,946, as shown in the accompanying summary. These figures are taken from the official smelter returns and are calculated on the basis of the market price of silver on the day settlement was made. The net return after deducting the freight-charges paid to the railroad, the Government tax, and the deductions and charges made by the smelting company is only $2,101,394. The difference is $777,552, or approximately $25 per ton, which may be considered as being the average cost of marketing $100 ore. This high cost results partly from the long haul and the prevailing high scale of freight-rates and partly from an unfavorable smelter contract. Obviously the question of marketing the product was of prime importance in determining the most suitable method of treating the lower-grade ore of the mine. It will be informing, therefore, to give some details regarding freight-rates and smelter-charges before starting the discussion of the metallurgic problems. The following schedule applies to shipments from the siding near the mine on the branch line of the Santa Fe railroad from Barstow to Johannesburg. The rate is based on the net smelter return.

Net return per ton	Freight-rate per ton
Under $30	$6.29
30 to 40	7.50
40 " 80	9.10
80 " 150	11.35
150 " 200	13.00
200 " 300	15.40
Over 1000	32.60

In addition there is a war-tax of 3% on the freight.

No. 2 SHAFT AND THE TRESTLE LEADING TO THE MILL

The freight to either of the plants in Salt Lake valley or to one of the smelters in Arizona would be higher than to Selby. However, if one of these smelters should offer sufficiently attractive charges, the difference in freight might be overcome. It seems probable that the California Rand company could at least induce the Selby smelter to make more liberal terms by negotiating with some other company to treat its ores. In any competition the Selby people, of course, would have the advantage because of the lower freight. Here follows a typical calculation of the settlement made by the smelter under the terms of the present contract.

Analysis of the Ore

Gold, oz	0.29	Sulphur, %	4.9
Silver, oz	88.8	Arsenic, %	1.14
Silica, %	80.1	Antimony, %	0.48
Iron, %	4.8		

Credit		Per ton
Gold, 95% of assay at $20 per oz		$ 5.51
Silver, 95% of assay at 99⅝c. per oz		88.05
		$93.56
Debit		
Arsenic and antimony, penalty on combined content of $2 per unit	$ 1.24	
Treatment, at $9 for $50 ore with 10% of the value in excess of $50, and up to $100	12.96	
		14.20
Net value of ore delivered at smelter		$79.36

One consignment (No. 302) contained 61,968 lb., net dry weight, of exceptionally high-grade ore. It assayed 1.4 oz. gold, 1336.1 oz. silver, 5.1% arsenic, and 5.8% antimony. The following summarizes the deductions and charges per ton of ore:

Penalty on arsenic and antimony	$19.80
Treatment	14.00
5% of silver	66.56
5% of gold	2.36
Freight	32.60
Tax	1.00
Total	$136.32

PRODUCTION RECORD, CALIFORNIA RAND SILVER MINE

	Month	Production, tons	Gross-value	Freight-charge	Tax	Treatment-charge	Net return Gold	Net return Silver
1919	June	55.90	$2,465	$352	$11	$440	$350	$1,312
	July	301.22	21,561	2,280	68	3,038	1,384	14,793
	August	707.55	148,753	7,884	237	9,303	4,036	127,293
	September	384.48	28,984	3,097	93	3,918	1,362	20,514
	October	648.36	30,518	4,056	122	5,906	2,340	18,095
	November	216.81	36,885	2,216	66	2,803	1,782	30,018
	December	656.57	84,536	6,356	191	8,114	3,194	66,681
1920	January	187.19	24,262	1,915	57	2,487	702	19,204
	February	345.02	47,419	3,566	107	4,421	1,840	37,486
	March	343.18	92,183	4,299	129	4,631	2,515	80,609
	April	173.96	22,234	1,739	52	2,264	634	17,545
	May	649.88	70,615	5,691	171	7,336	2,423	54,993
	June	636.72	38,981	4,581	137	5,199	2,103	26,961
	July	323.96	22,268	2,853	86	2,978	1,422	14,928
	August	1,227.16	100,127	10,927	328	12,347	4,858	71,667
	September	1,132.54	101,844	10,895	327	12,018	5,546	73,059
	October	622.80	54,170	6,847	205	6,637	2,285	38,195
	November	2,034.61	156,638	20,736	622	20,018	8,897	106,363
	December	2,806.63	299,481	32,421	969	31,705	14,137	220,249
1921	January	982.93	82,601	10,680	319	10,137	6,074	55,388
	February	806.56	96,691	9,883	296	9,723	4,580	72,208
	March	1,321.45	136,531	15,227	456	15,596	7,132	98,120
	April	1,045.50	89,283	11,305	336	10,975	7,818	58,819
	May	1,740.24	108,795	14,236	427	16,658	5,420	72,054
	June	1,587.02	119,585	13,806	414	18,284	7,702	79,378
	July	1,794.32	190,428	17,887	537	25,477	8,175	138,351
	August	1,556.11	175,813	16,098	482	22,279	6,148	130,804
	September	1,717.30	151,531	16,004	480	20,920	4,525	109,601
	October	1,839.24	130,937	15,868	476	20,502	1,942	92,147
	November	2,284.44	212,827	21,892	656	29,984	5,735	154,559
	Total	30,129.65	$2,878,946	$295,597	$8,857	$346,098	$127,061	$2,101,394

It has been proved to be not only possible, but practicable, to make a flotation product containing approximately 1300 oz. of silver per ton; one of the metallurgic problems will be to determine the final economic advantage or disadvantage of doing so.

One other factor in developing the best plan of metallurgical treatment is the lack of an ample supply of water near the mine. The nearest adequate supply is at Hinkley, 47 miles distant and at a much lower elevation. Pumping is out of the question even though a pipe-line of that length were feasible. The California Rand company owns some property about 5 miles east of the mine on which a water-shaft is now being sunk. At 130 ft. this shaft developed only 1500 gal. per day; however, it is expected to cut a known water-course at a depth of approximately 300 ft. Hope is entertained that a flow of some importance will result, but the actual supply, of course, is doubtful. The Randsburg Water Co. has some wells in the same vicinity, from which it supplies the town, but it has no appreciable excess to sell to the mining company. The only sure source is the railroad company's wells near Barstow. The Santa Fe company will supply the water without charge in order to get the resulting traffic, for the water must be hauled to the mine in tank-cars. The rate is $28 per car of 10,000 gal., and as the estimated requirements to mill 100 tons per day is 50,000 to 60,000 gal. the railroad will have a profitable business; and the California Rand company, on the other hand, will be obliged to make every effort to conserve water and to recover as much as is reasonably possible from the mill-tailing.

A third consideration, of an economic rather than of a distinctly metallurgic character, but one that has a bearing on the determination of the mill flow-sheet, is the royalty on the use of flotation. On account of the comparative smallness of their mine, the officials came to the conclusion that they could better afford to pay the royalties demanded by the Minerals Separation company than to fight it; accordingly they signed a license contract that provided two alternative methods of determining the royalty. These were: (1) a flat rate of 2½% on the value of the ore treated, or (2) 5c. per ounce of silver, and 50c. per ounce of gold recovered from any portion of the ore that might be treated by flotation. This high royalty made it imperative to investigate alternative methods of treatment with a view to reducing to the minimum the amount of precious metal to be recovered by flotation.

The following metallurgical engineering firms made tests on the ore: Hamilton, Beauchamp, Woodworth, Inc., of San Francisco; General Engineering Co., of Salt Lake City; Colorado Iron Works, of Denver; the Southwestern Engineering Co., of Los Angeles; and Minerals Separation company. The results of all their tests indicated that at least 96% of silver and 80% of the gold unquestionably could be recovered from the sulphide ore with a product of good grade and a satisfactory ratio of concentration. There is to be treated approximately 10,000 tons of oxidized ore, which, of course, does not respond as satisfactorily to concentration by flotation. The main problem, however, is the treatment of the sulphide ore from the levels below 150 ft.; in this the important ore-forming minerals are argentite (Ag_2S), pyrargyrite (Ag_3S_3Sb), proustite (Ag_3S_3As), and stephanite (Ag_5S_4Sb); besides these silver minerals there is the pyrite, with which most of the gold appears to be associated.

A VIEW OF THE MILL LOOKING NORTH

The most comprehensive tests were made by the firm of Hamilton, Beauchamp, Woodworth, Inc. I shall discuss sundry interesting features of their excellent report. Eight distinct processes or combinations of processes were tried. They were as follows:

1. Straight flotation (Mr. Beauchamp calls it 'bulk' flotation) of the entire feed with a view to obtaining a satisfactory extraction of both gold and silver with a low tailing.
2. Selective flotation, in which the endeavor was made to obtain a small quantity of very high-grade silver concentrate. The principal object was to lessen expenditure for freight.
3. Table-concentration of ore crushed to 30-mesh, followed by re-grinding of the table-tailing and subsequent flotation. The principal object was to lessen the royalty on flotation.
4. Selective flotation, as in (2), followed by concentration on tables to recover most of the pyrite with its associated gold, which would be dropped in the selective flotation.
5. Selective flotation, as in (2), followed by cyanidation of flotation-tailing to extract most of the remaining gold and silver.
6. 'Bulk' flotation, followed by cyanidation of the middling and tailing combined.
7. Cyanidation of the raw ore.
8. Concentration on tables followed by cyanidation of the tailing.

The tests demonstrated that only the first three schemes need to be considered from the standpoint of 'economic' realization, although some interesting results were obtained in the other tests. I shall refer to them by number.

1. Straight flotation of sulphide ore only.

Conditions of Test

Ore	80 mesh
Machine	Mechanical agitation
Circuit	Alkaline
Pulp dilution	4:1
Time of agitation	4 min. for concentrate 11 min. for middling

Reagents	Pounds per ton of ore
Water-gas tar	1.0
Stove-oil	0.7
Hardwood-creosote	0.2
No. 5 pine-oil	0.1
Sodium sulphide added in form of 10% solution	2.0

Results

		Assay		Content		Distribution	
Product	Weight, %	Gold,	Silver, oz.	Gold,	Silver, oz.	Gold, %	Silver, %
Heading	100.0	$3.10	28.25	....	.....	....	...
Concentrate	7.6	30.59	281.22	$2.325	21.371	67.78	82.2
Middling	8.4	9.09	45.16	0.763	3.793	22.26	14.6
Tailing	84.0	0.41	1.00	0.344	0.84	10.04	3.2

Analysis of Concentrate

	%		%
Arsenic	4.39	Iron	25.0
Antimony	2.03	Insoluble	23.6

'Eliminating' the middling, the following is the result:

Product	Weight, %	Combined value	Content	Distribution, %
Heading	100.0	$29.43	....	....
Concentrate	9.0	310.70	27.96	95.65
Tailing	91.0	1.41	1.27	4.35

Later I shall show the reasons that justify the conclusion that the return of the middling for re-treatment will not increase the precious-metal content of the tailing.

Carrying out the calculation similar to that made on a previous page for the smelter returns on shipments of ore, it is found that the concentrate made would yield from the smelter $253.99 per ton. If from this be deducted $7.77 (2½% of $310.72, or the assay-value of the ore, for payment of flotation royalty), the net economic realization per ton of concentrate is $246.22. Then

Assay-value of concentrate	$310.72
Economic realization	246.22
Loss per ton of concentrate	64.50
Percentage lost on content of concentrate	20.70

The concentrate from one ton of ore contains gold and silver worth $27.96, of which 20.7% is spent for marketing and for flotation royalty, leaving a net recovery of $22.18; or, based on the original ore, a net recovery of 75.8%. The flotation royalty would be 64c. per ton of ore milled.

2. Selective flotation of sulphide ore only.

Conditions of Test

Ore	80-mesh
Machine	Mechanical agitation
Circuit	Neutral
Pulp dilution	4:1
Time of agitation	5 min.

Reagents	Pound per ton of ore
P. E. collector-oil	1.0
Hardwood-creosote	0.3

Results

		Assay		Content		Distribution	
Product	Weight, %	Gold,	Silver, oz.	Gold,	Silver, oz.	Gold, %	Silver, %
Heading	100.0	$3.10	28.25	.....	....	...	...
Concentrate	2.20	50.64	1215.55	$1.114	26.74	31.7	92.6
Tailing	97.80	2.48	2.17	2.400	2.12	68.3	7.4

Analysis of Concentrate

	%		%
Arsenic	5.12	Antimony	7.74

Combining Gold and Silver

Product	Weight, %	Combined value	Content	Distribution, %
Heading	100.0	$34.42	....	...
Concentrate	2.2	1266.19	27.85	86.0
Tailing	97.8	4.65	4.52	14.0

The calculation of smelter returns on this concentrate shows that the net return after deducting freight, treatment, and penalties would be $1125.66 per ton. The flotation royalty would be 2.5% of $1261.64, or $31.54, leaving a net economic realization of $1094.12.

Then

Assay-value of concentrate	$1261.64
Economic realization	1094.12
Loss per ton of concentrate	167.52
Percentage lost on content of concentrate	13.28

The concentrate from one ton of ore contains gold and silver worth $27.85, of which 13.28% is spent in marketing and flotation royalty, leaving a net recovery of $24.15; or, based on the original ore, a net recovery of 74.5%. The flotation royalty would be 63c. per ton of ore milled.

3. Concentrating on tables followed by flotation of the tailing. The ore, crushed to pass 30-mesh, was concentrated on a quarter-size Deister-Overstrom concentrating table, making a finished product and a tailing. The tailing was re-ground and concentrated by flotation under the following conditions:

Ore	80-mesh
Machine	Mechanical agitation
Circuit	Alkaline
Pulp dilution	4:1
Time of agitation	15 min.

Reagents	Pounds per ton of ore
P. E. collector-oil	1.0
Hardwood-creosote	0.3
No. 5 pine-oil	0.1
Sodium sulphide	1.5

The proportions and analyses of the heading, the two concentrates, and the tailing produced follow:

Assay

Product	Weight, %	Gold,	Silver, oz.	Arsenic, %	Antimony, %	Iron, %	Insoluble, %
Heading	100.0	$4.77	26.88	...	...	...	...
Table-concentrate	8.0	40.00	202.50	2.67	1.83	28.85	25.0
Flotation concentrate	5.1	20.80	198.00	5.77	2.85	22.0	24.0
Tailing	86.9	0.62	0.70	...	...	...	...

Making the same calculations as before the following data are obtained.

Assay-value of table-concentrate	$241.73
Economic realization	192.58
Loss per ton of table-concentrate	49.15
Percentage lost on content of table concentrate	13.28

Obviously in the above no deduction need be made for flotation royalty.

From the net recovery per ton of flotation concentrate, $162.33, must be deducted the flotation royalty of 5c. per ounce of silver and 50c. per ounce of gold recovered by flotation. This amounts to $9.90 in this particular instance, leaving the economic realization $152.43. Then

Assay-value of flotation concentrate	$218.16
Economic realization	152.43
Loss per ton of flotation concentrate	65.73
Percentage lost on content of flotation concentrate	30.1

Reduced to the basis of one ton of ore milled, the loss in marketing table-concentrate will be $3.92 and in marketing flotation concentrate $3.38, making a total of $7.30 per ton, which on the heading assay, of $31.65, leaves a total net recovery of 76.93%. The flotation royalty is approximately 50c. per ton of ore milled.

Summarizing the results of the three methods:

	Metallurgical extraction, %	Economic recovery, %	Difference, %
1. Straight flotation	96.65	75.8	20.85
2. Selective flotation	86.00	74.5	11.50
3. Tabling and flotation	96.60	76.9	19.70

Before discussing these figures I shall state briefly the reason or reasons why each of the five alternative schemes proved impracticable.

4. It was impossible to obtain a satisfactory tailing when concentrating the flotation tailing. The colloidal slime interfered with the efficient separation of the pyrite with which the gold is associated.

5. A combined extraction of 49.1% of the gold and 98.7% of the silver was obtained by cyaniding the tailing made by selective flotation as follows:

	Gold extraction, %	Silver extraction, %
By flotation (in concentrate)	31.7	92.6
By cyanidation	17.4	6.1
	49.1	98.7

Apparently the gold is not readily amenable to cyanide; moreover the cost would be too high to justify cyanidation.

6. The following figures show the results of a test in which bulk flotation was followed by cyanidation.

	Gold extraction, %	Silver extraction, %
By flotation	73.6	86.64
By cyanidation	11.7	13.20
	85.3	99.84

Apparently it would be more economical to carry the flotation further and thereby avoid cyaniding.

7. Cyanidation of the raw ore was not only expensive, but failed to extract the metals.

8. Concentration preceding cyanidation indicated that cyanidation need not be considered seriously.

It happens sometimes that the return of a middling to the head of a flotation circuit will produce a considerably richer tailing in actual operations than is indicated by tests on clean ore, although it has been demonstrated repeatedly that the extraction obtained by properly conducted laboratory work can be duplicated or improved upon in a well-designed mill. A satisfactory method of determining the effect of re-treating middlings is the 'cycle' test, which may be performed as follows: A sample of the ore is divided into five or more equal lots. The first lot is 'floated', under the conditions previously found to be most desirable, to make a concentrate, middling, and tailing; the middling is added to the second lot and the flotation operation is repeated, the resulting middling being in turn added to the third lot of fresh ore for floating. This process is repeated until all the lots have been used, each tailing being reserved for assay. The results of such a series of tests conducted by Hamilton, Beauchamp & Woodworth on California Rand sulphide ore are shown in the following table:

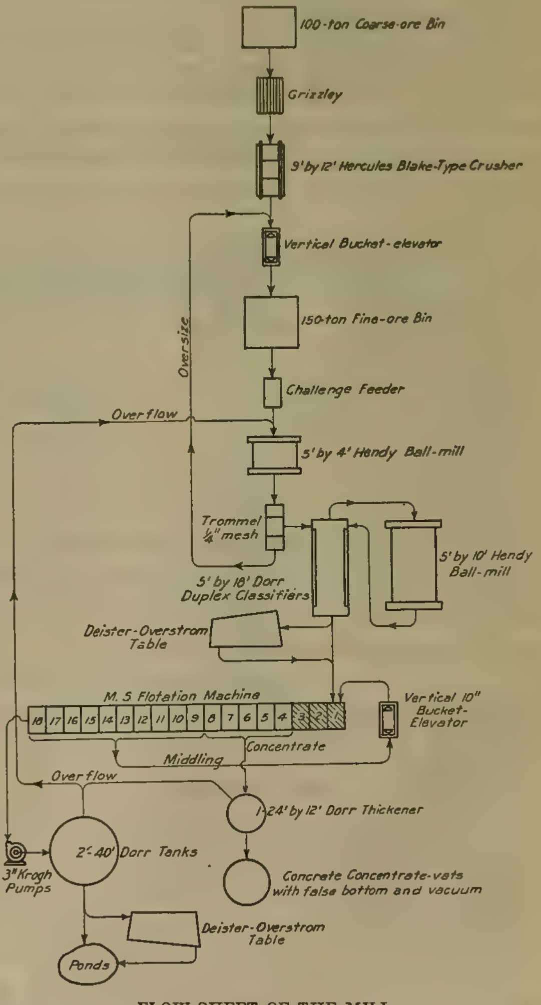
		Assay		Content		Distribution	
Product	Weight, %	Gold,	Silver, oz.	Gold,	Silver, oz.	Gold, %	Silver, %
Heading	100.00	$3.10	28.25	....	....	....	...
Concentrate	12.08	23.56	200.16	$2.846	24.180	84.80	88.8
Middling	3.60	8.27	66.50	0.298	2.390	8.88	8.8
Tailing No. 1.	13.04	0.41	0.80	0.053	0.104	1.04	0.4
" " 2.	18.00	0.20	0.80	0.036	0.144	1.07	0.4
" " 3.	18.32	0.20	0.80	0.037	0.147	1.09	0.4
" " 4.	18.48	0.20	0.80	0.037	0.148	1.10	0.4
" " 5.	16.48	0.41	0.80	0.067	0.132	2.01	0.7

The fact that the assays of tailings are virtually uniform indicates that the return of middlings for re-treatment will have no ill effect on the extraction, and warrants the 'elimination' of the middling and the averaging of the tailing assays as a basis for calculating the results.

A number of pertinent facts were revealed in the course of testing. It was found that the ore, which is easily crushed, produces a high proportion of 'colloidal' slime. If the ore is ground to pass a 100-mesh screen the following are the requirements for settling or thickening.

Final ratio Water : solid	Area per ton of ore per 24 hr., sq. ft.
3 : 1	6.8
2 : 1	11.7
1 : 1	20.0

A depth of 8 ft. in the settling-tank was adequate. It was found that the extraction of gold, associated with the pyrite, was greatly improved by using sodium sulphide or sodium carbonate in conjunction with oils such as those named in the tests already described. The 'dropping' of the pyrite by the non-use of these additional reagents was the basis for the proposed selective flotation. However, the use of either sodium sulphide or sodium carbonate had the effect of deflocculating the slime to such an extent that settling and the recovery of the water were almost impossible. Mr. Beauchamp, in an effort to prevent this, tried substitutes for the sodium salts, and demonstrated that calcium poly-sulphide, made by boiling lime with sulphur, would raise the pyrite successfully in the flotation cells without deflocculating the slime. All of Mr. Beauchamp's tests were made with mechanical flotation apparatus.



FLOW-SHEET OF THE MILL

The General Engineering Co. made a series of tests on a composite sample consisting of 80% sulphide and 20% oxidized ore and one test on sulphide ore. In this test the ore was ground wet in a ball-mill, with lime in the proportion of 2 lb. per ton of ore; 96% of the product passed a 65-mesh screen. The ground ore was floated in a Callow rougher-cell followed by a cleaner using 0.35 lb. of T. T. mixture (composed of $\frac{1}{4}$ thio-carbonilide and $\frac{3}{4}$ ortho-toluidine) and 0.1 lb. of aldol per ton of ore. The flotation tailing was concentrated on a Wilfley table. The summary of this test shows:

		Assay		Content		Recovery, or loss	
Product	Weight, %	Gold, oz.	Silver, oz.	Gold, oz.	Silver, oz.	Gold, %	Silver, %
Flotation concentrate	9.00	1.060	285.45	9.540	2569.05	65.70	93.40
Table-concentrate	2.10	0.890	28.80	1.869	60.48	12.87	2.23
Total concentrate	11.10	1.028	236.89	11.409	2629.53	78.57	95.63
Table-tailing	88.90	0.035	1.35	3.112	120.02	21.43	4.37
Heading	100.00	0.145	27.50	14.521	2749.55	100.00	100.00

This shows a ratio of concentration of 9.01:1 if the two concentrates be combined, with an extraction of 78.57% of the total gold content of the ore and 95.63% of the silver.

An analysis of the concentrate obtained from one of the tests on a composite sample indicates the approximate composition of the product that will probably be made in the new mill. This follows:

Constituents	%
Copper	0.11
Insoluble	30.6
Zinc	None
Sulphur	30.8
Arsenic	4.06
Iron	28.5
Antimony	1.62
Gold, oz.	1.280
Silver, oz.	255.30

The General Engineering Co. made an estimate of the cost of milling that is interesting. The figures are based on a 100-ton plant using Callow cells, assuming that water can be supplied to the plant by gravity, and that power can be obtained at 1c. per kilowatt-hour.

Power

Crusher, rolls, and elevator	30 hp.	for	8 hr.	240 hp-hr.
Roller-mill, feeder, and classifier	125 "	"	24 "	3000 "
Blower	20 "	"	24 "	480 "
Table and pump	5 "	"	24 "	120 "
Settling and filtering	15 "	"	24 "	360 "
Total				4200

Power, cost per ton		$0.294
Labor at a scale of $4.50 per day		0.57
Steel for rod-mill, 5 lb. per ton of ore at 6c.		0.30
Miscellaneous repairs and incidentals		0.25
Flotation reagents:		
0.35 lb. T.T.	10.50c.	
0.10 lb. aldol	4.00	
2.0 lb. lime	2.00	
License for reagents	3.00	
	19.50c. or	0.195
Total		$1.609

The most significant feature of these figures is the small cost of flotation reagents—only 19.5c. per ton of ore. The power required for flotation is, of course, small; the estimated cost is about 2.7c. per ton of ore.

The Minerals Separation company made a series of tests, the results of the final one being as follows:

					Recovery, or loss	
	Weight, %	Gold, oz.	Silver, oz.	Iron, %	Gold, %	Silver, %
Heading	100.0	0.14	36.54	4.4	100.0	100.0
Concentrate	7.3	1.20	483.60	28.5	60.4	96.9
Tailing	92.7	0.06	1.25	2.3	39.6	3.1

Screen-Analysis of Feed

	%
On 80 mesh	2.0
" 100 "	3.0
" 150 "	3.0
" 200 "	18.0
Through 200 "	74.0

The above data are part of the information that was available to M. N. Colman when he was engaged last July to design and supervise the erection of the concentrating plant. Details of the plan of treatment are shown by the accompanying flow-sheet, in which it will be noted that straight or bulk flotation in a Minerals Separation machine has been selected. The reasons for this choice were outlined to me by Mr. Colman. The advantages of flotation had been proved conclusively. It had already been decided by the officials of the company that a license would be obtained from the Minerals Separation company; accordingly the possible advantage of the pneumatic cell in saving 60c. per ton in royalties was not a factor to be considered. Moreover, sundry tests seemed to indicate that the smaller operating cost that would be obtained by using pneumatic cells would be approximately offset by improved recovery of the gold and silver in a machine using mechanical agitation. The choice of the Minerals Separation machine in preference to some other device using mechanical agitation was based on the belief that it was more nearly fool-proof than others, and that there would be less likelihood of experiencing temporary difficulty when the plant started to work. One of the principal considerations was to build a plant and get it in regular and successful operation in the shortest possible time.

Reverting to the comparison between the results of the three schemes of concentration—(1) straight flotation, (2) selective flotation, and (3) tabling and flotation—it will be observed that there is little to choose between them so far as the economic recoveries are concerned. The differences are so small that they might be accounted for by allowable discrepancies in the experimental work.

The apparent advantages of the third method are due entirely to the lessened royalty arising from the fact that only a portion of the ore is given flotation treatment. Against this must be placed the more complicated flow-sheet, and additional equipment, which would include provision for further grinding, and additional classification, and dewatering of the table-tailing before flotation; as well as, of course, the concentrating tables themselves. Moreover, if the extraction by tabling for any reason dropped appreciably, the flotation royalty calculated on the per-ounce-of-metal basis would increase rapidly. Mr. Colman concluded that the margin on which he had to work was not sufficient to justify the more complicated flow-sheet.

Selective flotation offered numerous attractive features: simplicity of flow was combined with high economic recovery, and at the same time a tailing was made that contained 68% of the gold and 7% of the silver, or 14% of the total precious metal in the original ore, which might be impounded and profitably re-treated at a later date. The construction of the plant is such that selective flotation of this character can be performed if it should appear advisable, but the intention is to use calcium poly-sulphide and obtain the maximum recovery as outlined under the discussion of straight flotation.

It will be noted that two ball-mills are provided and that stage-crushing will be practised. As a matter of fact this equipment is probably sufficient to grind 200 tons through 80-mesh. The apparent over-capacity will make it possible (*a*) to install tables for a preliminary table-treatment, if that should become advisable, without delay or inconvenience, or (*b*) to double the capacity of the plant by merely adding a second flotation unit and the necessary thickening-tanks.

Two Deister-Overstrom tables are to be used; one is a 'pilot' to reveal the character of the feed at any given time for the guidance of the operator of the flotation department. Part of the feed will be by-passed to the table, the concentrate and tailing being returned together. The second is styled a barometer because its function is to indicate the result of flotation. It is expected that almost no silver minerals will appear on this table.

The flotation machine is the new 18-cell M. S. type without separate compartments for frothing. It is proposed to use the first three compartments for agitation exclusively, and to start skimming froth at the fourth. Five compartments will make a finished concentrate, whereas the product from the final ten will be returned to the head of the cell.

Both the General Engineering Co. and Hamilton, Beauchamp, Woodworth, Inc., recommended a revolving vacuum-filter, but the present plan is to dewater the concentrate in a Dorr thickener and to collect and dry it in a concrete tank having a false bottom and being connected with a vacuum-pump. For 10 tons of concentrate per day this arrangement should work satisfactorily.

As I showed at the beginning of this article, the marketing of a 250-oz. concentrate is an expensive procedure, so that the concentration of 25-oz. ore in the ratio of 10 : 1 is not an adequate solving of the economic problem. The only satisfactory shipping product appears to be bullion; and the reduction of the concentrate to bullion at the mine probably will be accomplished eventually. Among the methods suggested are (*a*) smelting in an electric furnace, (*b*) smelting in an oil-fired reverberatory, and (*c*) chloride volatilization. It will cost approximately $55 per ton to market 250-oz. concentrate with a moisture content of not less than 10%, and the probability of saving from $25 to $40 per ton by local treatment is sufficient to make thorough experimental work highly attractive. Incidentally, this problem is a factor that may strongly favor the selective scheme of flotation; it may be that a small quantity of very rich concentrate can be smelted far more cheaply than three times as much that assays only 250 oz. Mr. Colman is investigating the question thoroughly and a successful treatment is likely to be developed, with a consequent saving of several dollars per ton of ore.

The photographs for the accompanying illustrations were taken at a later date than the photographs that were reproduced in the first article on the California Rand mine, which consequently do not show the mill. On page 13 is shown No. 2 shaft, the mine-dumps, and the mill-site soon after the contractors, Cahill & Vensano of San Francisco, commenced construction work in September. The second photograph was taken in December, after the plant had been finished. Early in the month the machinery was 'turned over' for the first time, the smoothness of mechanical operation speaking well for the work of the construction engineers. Treatment was commenced on December 15 on $10 ore. A recovery of more than 90% of the silver was made and this will doubtless be improved as soon as operation is properly systematized. The heading will be increased to approximately $30, the grade of ore used in making the tests; this change will have a favorable influence on the recovery, and it is confidently expected that the results indicated by the test-work will be fully realized.

EXPERIMENTS by repeated impact tests show that too much emphasis is often laid on the advantage of high resistance to a single impact. L. Guillet, who writes in 'Rev. Met.', states that failures are most often caused by the development of cracks from repeated stresses; the Stanton repeated-impact test was selected for comparison, and tensile and Brinell hardness tests were also made. In some instances the number of blows needed to cause rupture was found to rise with increasing values of the elastic limit, notwithstanding that the resilience had meanwhile dropped appreciably, in some cases as much as 50%. The extent of the increased resistance to repeated impacts in these cases, however, varied considerably with the height of fall of the tup, and the frequency of the blows, it being most marked when the fall was small (about 1.3 in.) and the frequency low (60 blows per minute). The author concludes that it is far better to have a steel with moderate resilience and a high elastic limit, rather than high resilience and low elastic limit.

THE results of gas-producer tests with Alberta coals, according to a Canadian Department of Mines bulletin, show that it is possible to operate the producer for considerable periods with all the fuels tested, except one; but less than one-half can be recommended for continuous operation in this producer. In order that a fuel may be suitable for use under commercial conditions it must be of a character which will permit it to pass regularly through the producer without necessitating excessive poking; it must not pack, cake, or clinker in such a way as to form channels which will prevent the even access of air to all parts of the fuel (this requirement outweighs all others); the coal must be capable of yielding a good quality of gas continuously, which, if required for use in an internal-combustion engine, must be fairly free from tar and lampblack. This condition is of great importance, unless the plant installed for generating a power-gas for burning in internal-combustion engines is large enough to warrant the installation of special scrubbers and tar extractors.

Co-ordination, Co-operation & Conference, Inc.

By C. T. Hutchinson

No great amount of thought is required to bring about a realization that our forefathers had the better of us in many important respects. George Washington never had to dodge a Ford in crossing the street to his place of business in the morning. When Patrick Henry gave vent to his famous remarks about his preference for a quick demise if he could not exercise his God-given right to do as he pleased, he little dreamed of the coming of the Eighteenth amendment.

Modern industrial development has brought in its wake new complexities. The mechanic has suffered; in fact, it is claimed that there are no more mechanics. The story goes that a man seeking work at the employment window at one of our iron works, in response to the query as to where he had worked and what he had done, replied, "I have been working in Detroit at the Ford factory, where I tightened the $\frac{5}{8}$-inch nuts on the right side of the chassis assembly". We have no more machine-tool operators, only men who operate specific machines of certain sizes. The planning room plus the jig and gauge department furnish the brains. The men merely go through the motions.

The old-time merchant led a many-sided existence. He was a trader who imported goods and commodities of all kinds from Europe, and sent in exchange the products of the new world. He chartered ships, he financed exploration expeditions, he grub-staked trappers and adventurers of all sorts. He did a banking business as well; in fact, he was and had to be a versatile man, and was one of the great factors in blazing the trail of civilization.

Since then the acorn has become a sturdy oak. As the oak grew it acquired branches, and more branches. Soon the foliage became so thick that no man could see through it. And so it is with the organization of our so-called big business. No one man, and few groups of men, can see through them. From the individual the organization of business progressed as it expanded to the partnership, then the corporation, followed by the merger of many corporations into what is called a 'Trust', with a big T. John Smith, Blacksmith, has become Universal Steel, Ltd., with ramifications extending all over the globe, with iron and coal mines, coke-ovens, railroads, blast-furnaces, rolling-mills, fabricating plants, and machine-shops. In addition there are the legal, political, financial, engineering, and sales forces, while the various phases of statistical, general, and cost accounting, all evolved from the labors of the simple clerk with his quill pen, form a vast and complicated network of sublimated pen-pushers.

If it be good policy to keep one's right hand in ignorance of the activities of one's left, then modern organized business is efficient to the last degree, for nowadays even the fingers of both hands and the toes of both feet of the business corporation are housed separately behind ornate glass partitions where each may do its own little trick without knowledge of its relation to the doings of its little playmates. Instead of the antiquated book-keeper, we have the custodian of the bills-receivable ledger from A to D. Each old book of a set has been split into a multiplicity of books, while have been added oodles of other books with fearsome names and of awe-inspiring importance. Then, by means of the loose-leaf system, these books in turn can be kept on the homeopathic plan, by still further splitting into more and more parts. Since the books reflect the business that they are intended to record, a similar splitting into sub-divisions has taken place in the organization of the multitude of specialized-production departments, and supervision is correspondingly complicated. Machine-tools of the same class and within certain size-limits come under the supervision of straw bosses, whereas erection and assembly of parts are supervised by similar bosses in charge of sub-assemblies. So, up the line, one progresses from little bosses to bigger and bigger bosses, assistant foremen to foremen, then to group superintendents with their assistants, general superintendents with assistants, and assistants to assistants, and so on until we come to such haughty potentates as the various kinds of managers at or near the peak of the production end of the industrial structure. The engineering and accounting part of the work is similarly organized. It is the apotheosis of specialization. At the same time, down among the moiling and toiling privates of industry it is the quintessence of monotony.

Eminent psychologists and profound students of so-called human engineering are acquiring a series of headaches in the effort to counteract the inevitable result of this state of affairs. The psychology of the toiler is being studied exhaustively. The mental reaction from the nature of his work is obvious. Since he cannot experience the pride of the creator by drilling some hundreds of perfectly round $\frac{5}{8}$-in. holes every working day, his fancy lightly turns from his work, with its absence of the imaginative appeal, to thoughts of drilling fewer holes and dreams of exacting higher wages.

Much money and effort are being expended to sell the 'loyalty' idea to the countless thousands, as a substitute for the natural interest that results automatically from a job that requires thought, skill, and judgment. Thus we have with us such things as welfare work, locker-rooms, shower-baths, club-houses, baseball teams, and model cottages, but, like all substitutes, they are but substitutes after all. It is not at all unusual to find the machine-tool operator fussing with a home-made electric generator, a wireless set, or a gas-engine at his own little workshop in his cellar after so-called working hours, in order to satisfy that craving to create something which is denied him by the specialization of modern industry.

A similar extension of the specialization idea has taken place in the marketing of goods. It is no longer a salesman or two but a great number of salesmen divided into groups, each group specializing upon the sale of a specialized product of the manufacturer. Similarly in the advertising department there are advertising specialists whose efforts are concentrated upon the development of ideas pertaining to the needs of specific classes of people for specific things. Specialization upon any one thing must inevitably mean concentration of all of one's mental effort upon that one thing to the exclusion of all other things. The character of the work of the specialist in industry, and its tendency toward the creation of an atmosphere of mental exclusiveness, renders the worker oblivious to what is being done by other workers in the same establishment. In fact, it has brought about a detached feeling, a feeling of dissociation from personal responsibility. When mistakes occur, as they sometimes do, regardless of the theoretical efficiency of the organization, it is almost impossible to pin the responsibility any more closely than upon a certain department. The individual worker does not care or know particularly whether things go wrong so long as it is not his fault, and he develops great skill in the well-known indoor pastime of 'passing the buck'. It has become increasingly evident that instead of creating a thoroughly homogeneous organization of perfectly co-ordinated parts there is instead a heterogeneous mass; in theory one, but practically an infinite number of, independent little organizations within a greater organization, each little independent organization with its nose close to the grindstone of its own specific task without knowledge or interest in the relation of that task to the whole.

In the due course of human events a new word burst into the vocabularies of the super-organization managers. That word was 'co-ordination'. The world of industry is still striving mightily to bring about the result indicated by this verbiage. Co-ordination is the glue that purports to make a lot of little ones into one big one. Some progress is being made, but the amount of progress that has been made compared to the amount that ought to be made is so small as to give emphasis to the fact that the lack of co-ordination between departments of big businesses is the greatest weakness in the super-business organization of today. As a 'first aid' toward the achievement of coordination, the inter-departmental conference has been devised. There is something about the word 'conference' that carries with it a suggestion of dignity; it connotes momentous discussions between the great. There is an atmosphere of richly furnished rooms with mahogany tables, opulent arm-chairs, oil paintings of past industrial leaders on the wall, velvet carpets, Persian rugs, imported cigars, and soft-footed secretaries trotting in and out carrying papers, documents, and reports to the various conferees.

The word 'conference' has been taken up by everybody, that is, everybody who has a particle of imaginative quality. It seems that the smaller the business concern, the more conferences they have. Sometimes when the business organization consists of one man and his stenographer, he, too, is addicted to conferences, if only with himself. In the old days the bill-collector, whose presence was, one might say, inopportune, would be greeted with the salutation, "The Old Man is out". How much more elegant it is to have the attendant at the counter say instead, "Mr. Blank is in conference and cannot be disturbed". It should be added, however, that due care must be exercised to see that Mr. Blank does not conduct his conference behind a transparent glass-door, through which the collector may have his delusions shattered by seeing the conferee with a cigar in his mouth illustrating to an admiring friend a new way of swinging a mashie.

There is no doubt but that the original purpose of the creation of the super-organization was to lower the cost of production in order that more and better goods would find their way into the households of more people. This has been done to a considerable extent in spite of the obvious faults of the methods employed.

Marketing methods have not progressed so rapidly as production methods, not that the actual distribution of the goods is particularly at fault but that the personal element of service is lacking in most cases. In the old days, one had dealings either with the boss himself or with someone else in a position of real authority. Now the consumer does not come within miles of anyone at the top. He meets a salesman who is greatly circumscribed by regulations in the authority that he is permitted to assume. Any transaction that deviates ever so slightly from the conventional must travel upward along a slow and tortuous path from little boss to big boss, humbly asking approval on the way.

Prices are made by the price department. The terms of sales are the joint efforts of the legal department, the credit department, and the director of sales, perhaps. The goods are shipped by the shipping department over routes dictated by the traffic department until they arrive at or near the warehouse of the district sales organization, where they are unpacked, inspected, inventoried, and held pending an order that must be O. K.'d by an imposing collection of dignitaries before the goods are permitted to go to the consumer. The consumer, of course, must or ought to read carefully the voluminous contract that he must sign. The chances are that he does nothing of the sort. It is a curious thing that where a man will read most carefully a contract written in longhand or type-written, there is an air of finality about a printed contract that carries with it an atmosphere of immutability. So the purchaser looks, perhaps, to see that his name and address are spelled right, he turns the pages over to glance at the various fill-ins, and then signs his name. Most conventional contracts authorized by big industrial concerns are full of bugaboos and legal dodges prepared by attorneys skilled in circumlocution, whereby the company disclaims responsibility for almost everything. There is, of course, the time-honored strike clause, the one claiming immunity from such occurrences generally described as acts of God, the guarantee with a string on it wherein the seller agrees to replace at his expense F.O.B. factory such part or parts as shall prove to have been defective when shipped, provided that they have been used for the purpose ordered, provided that they shall be returned to the factory for inspection within a certain time after date of contract, but providing that no claims for labor or damages will be allowed. If the transaction is not a cash-in-advance one, and few of them ever are, all sorts of dire things are provided to happen to the purchaser if his payments are not made in the manner and at the time specified, although the seller seldom agrees to use anything more than 'due diligence' in making shipment on the date specified. There is the conditional bill-of-sale clause, wherein title to the goods rests with the seller until all payments provided shall have been made, and there is that unctuous phrase of which the legal gentry are so fond, "Time is of the essence of this contract".

On the face of it, such contracts are holy terrors; but, practically, it seldom works out that way. Big business is jealous of its reputation, and is prompt to acknowledge and to rectify faults if it be in the wrong, contract and legal technicalities to the contrary notwithstanding. Frequently it goes beyond what might reasonably be expected of it, even to the point of conceding claims that it knows are unjust. The customer is not always right, but he gets the benefit of the doubt nearly always.

Most of our industrial leaders found out early in the game that the more lawyers they had messing around in the relation between buyer and seller, the worse off they were; thus the imposing two- or three-thousand word contracts have become dead letters in many respects. Branch managers are authorized to use their own discretion and decide disputes upon their merits, knowing that in so doing the general-sales managers will fight their battles for them with the production department. A real structural defect in a piece of machinery that fails under normal working conditions is generally fairly obvious. On the other hand, there are certain types of buyer who consider that they have done something smart if they can bluff the manufacturer into making a replacement or effecting repairs free of charge, although necessitated by some fault of their own, while at the same time they would shudder at the mere suggestion that they might pick the manufacturer's pocket. If the lawyer as a class could be debarred from inserting his oar into the relationship between buyer and seller it would be easier to effect sales. The simplest kind of a contract form is the most effective, and, curiously enough, will stand in law just as well as a portentous document fairly bristling with ifs, ands, buts, whereases, aforesaids, and to-wits.

The evolution of little business into big business may be likened to the transition from the log cabin to the Woolworth building. In the old days one could walk through the doorway and there was the boss sitting in front of him. Nowadays it is a great man indeed who can get within a mile of the boss of a big industrial institution. As some one once said of E. H. Harriman, "he travels on a higher plane", and most of us who make up the sub-stratum of the industrial scheme of things get no more than the merest worm's eye view of the snow-capped peak of the higher altitudes. Consider the case of plain John Smith of Podunk. He is a prosperous dealer in, let us say, supplies. In his own home town he is quite a fellow. He belongs to the Elks, has a credit rating of $50,000 at the First National Bank, passes the plate at the First Presbyterian Church on Sunday, wears a frock-coat, and drives an automobile. He is on first-rate terms with the salesman who covers his territory and, in fact, has been persuaded by this self-same salesman that he is a pretty big fish. John Smith thereupon decides to take a little trip to New York, perhaps with his wife, where they can see the wheels go around in that big and wicked city. He drops a hint of his intention to the salesman of the big manufacturer, and the salesman, if he knows his business—and most of them do—advises his immediate superior that one of his hick customers is about to visit the big village, and gives him strong admonitions not to permit anyone to sell this hick the Aquarium, the Liberty statue, or tickets to Central Park, and to be sure to detail some one to take him and his wife to the Winter Garden, and possibly the Amsterdam Roof. John Smith thereupon proceeds to New York City and makes up his mind he is going to drop in upon the president of the manufacturing establishment with which he has been doing business for many years, just to make his acquaintance as the folks do down in good old Podunk. Here is where John Smith begins to get his first jolts. With the memory still in his mind of the size of his first breakfast check he braves the terrors of the Subway, and finally emerges breathless, somewhat dishevelled but triumphant, in lower Broadway, where, after discussing the matter with several Tammany policemen, he is directed to an imposing pile of steel and granite and is shoved into an express elevator that does not stop short of the 30th story. After a hair-raising journey toward the clouds, during the course of which he plays the ignominious rôle of a sardine pressed between a score or so of gum-chewing stenographers, brokers' clerks, and other malefactors, he gets out at the 35th story into an atmosphere redolent of luxury. There before him is a beautiful lobby—mahogany furniture, Turkish rugs, potted plants with brass jardinieres. A uniformed attendant disentangles himself from a swivel-chair, reluctantly puts down the sporting sheet of the 'Times', and looks inquiringly and with uplifted eyebrows at our friend Smith of Podunk, as if faintly inquiring as to 'How on earth did you get here?' The following dialogue then ensues:

"And whom do you wish to see?"

"Mr. Kilowatt Money Bags."

"Mr. Kilowatt Money Bags?"

"Yes, Mr. Kilowatt Money Bags."

"Do you mean you want to see Mr. Kilowatt Money Bags, the President of this Company?"

By this time Mr. Smith is getting a little warm.

"Yes, I want to see Mr. Kilowatt Money Bags, the

President of this Company."

"Do you know Mr. Money Bags?"

"No, I don't know Mr. Money Bags."

"Oh! Have you an appointment?"

"No, I have no appointment. I just arrived in town this morning from Podunk."

"From Podunk? What is Podunk?"

"Podunk is a place."

"Do people live there?"

By this time Mr. Smith is boiling.

"Yes, they live there. As a matter of fact, I am one of the people who live there and, for your further information, I am in the supply business. I am a customer of Mr. Money Bags. In fact, I buy about $50,000 worth of goods from him every year. He seems to want my business and I wanted to see what he looks like. If he don't want to see me he can go to the devil."

This last remark seems to shock the attendant. He offers the following:

"Perhaps you would like to see Mr. Volt Meter?"

"Who is he?"

"He is the assistant to the assistant clerk who has charge of the waste-baskets on Monday, Wednesday, and Friday."

By that time Mr. John Smith of Podunk has gathered a lot of valuable information about the free and easy ways of big business. Incidentally, he has lost his temper, and Mr. Kilowatt Money Bags has lost a customer.

This, however, is the modern idea. It pervades the entire general headquarters structure. The same ridiculous amount of swank is staged regularly by the little bit of organization that consists of about one and a half individuals. The executives follow the plan made famous by the ostrich. They stick their heads into the sand and hide away from those who would do business with them. It is the outer fringe of their organization only that comes into actual contact with those with whom the big company is doing business. In order to make it more imposing, new and strange titles have been invented to fit the greatness of these dignitaries. In the old partnerships it was quite a thing to be a member of a firm in good standing. When the corporation came we had a president, a vice-president, a secretary, and a treasurer. Now the mere president is quite a distance below the actual throne. Over the president we have no less a personage than a chairman of the board of directors or, perhaps, a chairman of the executive committee. That is as far as we have been able to go to date, but there is no doubt that within the next half-century we may even have to refer to Burke's Peerage or the Almanach de Gotha to obtain suitable titles to measure up to the importance and dignity of the industrial leader of the future. The real, red-hot democrat of an American has a genuine love for titles, the Constitution to the contrary notwithstanding, and the innumerable fraternal organizations supply that which the law of the land forbids. What is a paltry Duke or Earl compared to an Illustrious Potentate? What chance does a Baron or Count stand compared to a Grand Exalted Ruler? Solomon in all his glory was not arrayed as even the humblest of supreme generalissimos, or eminent grand somethings or other, in full regalia mounted on a prancing charger in the Fourth of July parade. Even the staid and dignified Family Club of San Francisco has conferred the title of mother-in-law upon its titular head, while a fraternal organization, known as the Bundle of Sticks, has adopted the Rooseveltian appellation of the Big Stick for the highest honor within its gift.

It is an insignificant executive indeed who does not have a group of assistants in various capacities. Whereas the vice-president in the old days was supposed to be second to the president, we now have a whole flock of vice-presidents in charge of finance, sales, production, engineering, etc. Then we have assistants to the president, vice-presidents, and so on down the line. Again we have secretaries to these various scions of the industrial aristocracy, and worse yet, there is the secretary to the secretary to the president, rendering even greater the splendid isolation of the big boss himself.

Industrial life is indeed complex; in fact, as one might say, it is becoming 'complexer and complexer'. Perhaps the strange part of it all is that those who are playing major rôles in the modern drama of business have had their sense of humor so atrophied by contact with money in large gobs that they don't know how funny the pomp and circumstance with which they surround themselves really are. They don't realize the sort of reaction an average man gets out of receiving what is obviously a circular letter designed for the purpose of selling him something—sent out in the name of a man high in the industrial world—that begins in the most familiar way with "My dear Mr. So and So", is signed with a rubber stamp, and bears every evidence on the face of it of a mimeograph job, not too good, with a fill-in at the top. This sort of a letter, together with the other one, is in many respects like the former except that at the bottom it carries a rubber-stamp communication which conveys the pleasant information to the recipient that "This letter was dictated but not read by Mr. Great Man, who was called out of his office before having an opportunity of signing his mail".

Is it possible to bring about a reversion to the simple ways of former days, or have the complexities of modern business life rendered impossible forever the old familiarity and cordial personal relationship in business dealings? Personal contact still exists, of course, but with the fringe rather than with the responsible heads of big business. All of this adds greatly to the burdens of the big boss himself, whose information comes to him after passing through a multiplicity of hands, subject to emasculation by each to serve his own particular self-interest. The pulse of business has become a myriad of little pulses, setting in motion currents and counter-currents, the direction of which is difficult to trace and even more difficult to analyze. The hope for the future rests with Co-ordination, Co-operation & Conference, Inc., all of which working in harmony constitute the three-point suspension upon which depends the stability of industry.

Book Reviews

Arihitects' and Builders' Handbook. By F. E. Kidder and T. Nolan. 1907 pp., ill. John Wiley & Sons, New York. For sale by the 'Mining and Scientific Press'. Price, $7.

This is the seventeenth edition of a well-known treatise, the name having been changed from "pocketbook" to "handbook." The chapters of Part II have been revised to make the data agree with the latest research and practice, and two new chapters have been added. In Part III the sections on heating and ventilation have been re-written by Rudolf P. Miller. Numerous articles have been added on a variety of subjects. The handbook is compact and has been prepared in convenient form. It will retain its position as a standard reference work on building construction.

Graphical Analysis. By W. S. Wolfe. 374 pp., ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $4.

This book is a development of notes and blue-prints prepared by the author and used in his classes at the University of Illinois, where he was formerly instructor in architectural engineering. Emphasis is placed on the analysis of stresses, rather than on design or the computation of loads, although one chapter is devoted to design and the determination of loads. A thorough mastery of the constructions and solutions presented in this book will give the student an excellent grasp of the subject. The contents are as follows: General methods. Centroids. Moments. Beams. Trusses. Moving loads. Masonry. Reinforced concrete. Design. Miscellaneous problems.

Practical Refrigeration. Compiled by the Editorial Staff of 'Power'. 283 pp., ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $2.

This volume of facts on the subject of refrigeration has been compiled from articles that have been written in 'Power' and which were of particular value to engineers. A considerable amount of space has been given to the question of indicating the mechanical work of the ammonia compressor; it has been felt that a more general use of the indicator would do much to improve its efficiency. The contents of the book are as follows: I. Refrigerating and steam plant. II. Ammonia compressor. III. Use and care of the compressor. IV. Ammonia condenser. V. Evaporating systems. VII. Insulation. IX. Carbon dioxide machine. Tests. Appendix. Tables.

Fire Prevention and Fire Protection. By J. K. Freitag. 1038 pp., ill. John Wiley & Sons, New York. For sale by 'Mining and Scientific Press'. Price, $5.

According to the statistics of the National Board of Fire Underwriters, our annual fire losses are still mounting steadily, for, instead of an annual loss of about $217,000,000, as was true during the period from 1900 to 1909 (which included the Baltimore and San Francisco conflagrations), the annual loss in the United States during the five-year period, 1915 to 1919, inclusive, was nearly $300,000,000. This steady increase shows conclusively that fire prevention and fire protection are still matters of serious economic importance. The author of this volume has endeavored to present, in a manner suitable for ready reference, the present status of the matter as applied to buildings, including many details of construction that should prove of value to architects, construction engineers, and underwriters, and a discussion of those broad preventive means and principles of scientific fire-protective design without which constructive details are often of little avail. The volume under consideration is a second edition, in which many revisions have been made to bring the subject-matter up to date, particularly in regard to approved design, construction, and equipment. Extensive additions have been made in the chapters dealing with theatres and garages. All references to comparative costs have been omitted, other than in regard to mill buildings. The contents are as follows: Part I. Fire prevention and fire protection. Part II. Fire tests and materials. Part III. Fire-resisting design. Part IV. Fire-resisting construction. Part V. Special structures and features. Part VI. Auxiliary equipment and safeguards.

Silica and the Silicates. By J. A. Audley. 374 pp., ill. D. Van Nostrand Co., New York. For sale by the 'Mining and Scientific Press'. Price, $4.50.

This is another of the series of volumes prepared and in preparation dealing with industrial chemistry. In the present case no author who writes in English appears to have attempted before to cover the same range of subjects within the limits of a single volume; the French treatise of Le Chatelier and the German book of W. & D. Asch are on entirely different lines. The subject has been treated from the chemical rather than from the engineering standpoint; the book contains a general survey of the industries concerned, showing how chemical principles have been applied and have affected manufacture. The influence of new inventions is also shown. A selected bibliography follows each section. Statistical information has only been introduced in so far as it illustrates the line of argument used. The contents of the book are as follows. Silica. Silicates. Lime, cement, and mortar. Ceramic industries. Glass and enamels. Miscellaneous application of silicates.

Deep-Well Drilling. By W. H. Jeffery. 531 pp., ill. Published by W. H. Jeffery Co., Toledo, Ohio. For sale by the 'Mining and Scientific Press'. Price, $5.

As stated in the preface, well-drilling is an ancient craft. Deep-well drilling, as practised today, began with the drilling of Drake's first oil well at Titusville, Pennsylvania, in 1859. The work of drilling deep wells in search for and in the development of petroleum deposits, stimulated by the development of the internal-combustion engine, has spread to many other parts of the world, and has developed into one of the foremost industries of the United States. The search for petroleum is destined to lead the driller to the uttermost parts of the world; several schools now offer courses in petroleum technology; the University of California has a course in well-drilling methods; it is to be hoped that some of our universities will add to their curricula a complete course in deep-well engineering, for the drilling of a well 5000 ft. deep, or drilling in a foreign country in which the geologic formations are not familiar, are both engineering undertakings of considerable magnitude. The author has undertaken in this volume to cover the process of well-drilling by the two methods now most generally used: the cable tool, and the hydraulic rotary drill. Subjects treated include the building of the derrick, drilling, handling the casing, fishing for lost tools, and the completion of the well according to the best practice of present-day expert drillers. Complete contents are as follows: I. Geology. Origin of petroleum and natural gas, with bibliography. II. Standard or cable-tool system of drilling—rigs, derricks, specifications, and drilling outfits. III. Standard or cable-tool system of drilling—spudding, driving pipe, drilling, under-reaming, and bit-dressing. IV. Fishing for tools that are fast or lost in the hole. V. Rotary process for drilling. VI. Combination cable and rotary system of drilling. VII. Drilling by the hydraulic circulating system—use of mud-laden fluid. VIII. Casing methods—casing used in various fields, collapsing pressures, safe lengths of string, casing equipment. IX. Use of packers. X. Cementing casing—shutting off bottom water. XI. Shooting wells. XII. Finishing the well—pumping equipment, setting screens, washing wells, shutting in gas wells. XIII. Cost of drilling wells in various localities. XIV. Strength of materials. XV. General information. XVI. State laws.

REVIEW OF MINING

INSTRUCTIONS FOR WAR MINERALS RELIEF CLAIMANTS

The Secretary of the Interior, in a notice to war minerals relief claimants, announces that motions for re-hearing on claims heretofore passed on or excluded must be submitted in writing to the War Minerals Relief Commission not later than February 15 next, plainly designating the claim and specifically stating the grounds upon which re-hearing is asked. If the claim, or part thereof, for which re-hearing is asked has heretofore been rejected on the ground that there was no government request or demand, the written motion must be under oath setting forth:

Anaconda Hill, at Butte, Montana

(1) The exact character of the "personal, written, or published request, demand, solicitation or appeal" which stimulated the claimant to produce or prepare to produce the mineral.

(2) The government agency mentioned in the Act from which the request, demand, solicitation, or appeal came.

(3) How or by whom the request, demand, solicitation, or appeal was communicated to the claimant.

(4) The time and place of such communication.

If the claim has been rejected or partly rejected on other grounds than the question of stimulation, the errors complained of should be stated in detail. As to claims heretofore excluded, if the claim is one which was mailed in time but not received in time by the commission so that no action has ever been taken on it, written request for a hearing filed with the Commissioner not later than February 15 will be granted and the claimant is advised to proceed with diligence to establish the claim by proof before the Commissioner.

RESUMPTION OF PRODUCTION BY THE ANACONDA COPPER CO. AT BUTTE ON JANUARY 16 IS ANNOUNCED. WAGES REDUCED 50 CENTS PER SHIFT

John Gillie, general manager of mines for the Anaconda Copper company, announced on December 29 that ore-production would be resumed on January 16 and that the number of employees would be substantially increased starting with that date. He stated that the number of men to be employed and the scale of production had not been definitely determined, but indicated that there would be a gradual increase. The start will probably be made at the zinc mines, since it is announced that the company plans to produce from 6,000,000 to 7,000,000 lb. of zinc per month at the electrolytic refinery at Great Falls.

Gillie says that his company expected to commence on January 16 to prepare to resume operations at several of its copper mines. The reduction works at Anaconda will also then commence preparations for resumption.

At the same time the following announcement was made public by the managers of all of the companies operating at Butte:

"To employees of the undersigned mine operators:

"For the past nine months the properties of most of the large producers of copper and zinc in the United States have been shut-down.

"This was necessary on account of the very large stocks of these metals on hand and the lack of demand of market, making it impossible to sell the metals upon a fair basis.

"The situation at this time is that while stocks have been materially reduced, the prices are still very low and the demand is not, and the probable consumption for a considerable period does not promise to be, sufficient to absorb large production, and capacity production is one of the proper conditions for an economic operation.

"It is obvious that any resumption of operations by the metal producers must be under curtailed production and more economical conditions, and, under these circumstances, the only possibility of continuing lies in co-operative effort between employers and employees.

"Copper and zinc costs must be reduced to the point at least covering the cost of production. The cost of supplies is gradually coming down. The most important item is the payroll, and this applies with particular force to the Butte district.

"It is proposed to start about the 16th of January to reopen some of the mines, and our aim is to arrive at a steady and continuous operation, which will inure to the benefit of employers and employees alike.

"Therefore, taking effect on the morning of January 16, 1922, a horizontal decrease of 50c. per shift will be put into effect.

Butte & Superior Mining Co., by Charles Bocking.
Tuolumne Copper Mining Co., by Paul Gow.
Moulton Mining Co., by W. C. Siderfin.
Elm Orlu Mining Co., by W. N. Rossberg.
Timber Butte Milling Co., by W. N. Rossberg.
Anaconda Copper Mining Co., by John Gillie.
Davis-Daly Copper Co., by J. L. Bruce.
East Butte Copper Mining Co., by P. F. Beaudin.
North Butte Mining Co., by L. D. Frink.
Butte Bullwhacker Mining Co., by H. A. Frank.
Mines Operating Co., by H. A. Frank."

PAXTON ANSWERS LETTERS OF HENRY ENGELS TO STOCKHOLDERS OF ENGELS COPPER COMPANY

E. E. Paxton has made a formal reply to the charges made by Henry Engels in a letter to the stockholders asking that their proxies for the annual meeting to be held on February 13 be given to Engels instead of to Paxton. The statement says in part:

Power Contract: Most of the stockholders are familiar with our long controversy with the Great Western Power Co. in whose exclusive territory our mines are located. Two long hearings were held before the State Railroad Commission on the question of rates and service. Partial relief was granted by the Commission and the suit subsequently brought in Court was compromised by our securing the lowest schedule of rates on the Great Western Power Co.'s system.

Smelting Contract: We at all times have had, and now have, a satisfactory contract with the American Smelting & Refining Co. A few months ago we secured a special concession from them to help tide us over the extreme depression in the copper market.

Shipping Contract: We have no such contract. The rates of the Western Pacific Railroad have been reduced on two different occasions from the high rates that were in effect in 1918. Everyone is familiar with the general advance in freight-rates during that year. After much negotiation and a trip to Washington, the last increase of 25% was removed on our concentrates. These reductions have effected a saving in excess of $120,000, per annum.

Auditing: Our accounts are regularly audited by Messrs. Klink, Bean & Co., whose certificates have been published in each of our annual reports, and their detailed statements may be inspected at any time at the office of the company.

Mining Engineer: Mr. Engels apparently ignores the fact that the mining and milling operations are in charge of Robert A. Kinzie, mining engineer. The excellent mill results attest the good work being done by him and the company invites inspection of its property by any stockholder or reputable engineer.

Bank Loan: The loan of $350,000 to this company by the Equitable Trust Co. of New York was for eighteen months from May 1, 1921, at 8%, which was the current rate of interest at that time. The security given by this company was $392,500 par value of stock of the Indian Valley Railroad Co. No commissions whatever were paid in connection with this loan which was secured with the assistance of the Western Pacific Railroad. The condition was made that as long as we shipped a minimum of 1200 tons of concentrates each month we could draw a maximum of $35,000 per month from the funds on deposit. If we ceased shipments for two months, then the funds on deposit were to be paid back on account of the loan but no demand was to be made on the amount already drawn. There is no obligation whatever that the company continue operations unless it desires to do so. By making this loan, the necessity for an assessment was avoided or the calling in of the remaining 'E' warrants at a time when conditions were unfavorable for so doing.

Shutting Down: Shut-down costs would have been greater than any operating loss, and, in view of the large orebodies developed, the directors concluded to push development work, particularly commencing the construction of the 7500-ft. tunnel, or No. 10 adit, which will strike the Engels mine ore 500 ft. below the present lowest workings. This tunnel is 25% completed and will obviate the pumping of water and hoisting of ore for many years to come and in many ways will reduce operating costs to a minimum. Present conditions have justified this policy.

It is needless to state that during the past three years the copper-mining industry has experienced the most severe crisis in its history. Extreme high operating costs, shortage and inefficiency of labor, and low market price for copper combined to close down nearly all of the copper mines in the United States. Our justification for operating under these conditions is the large amount of development work that has been accomplished and the splendid condition of the property at this time. Furthermore, an excellent organization has been held intact and the company is now, and has been, in position to take advantage of the rising market with increased output.

AMERICAN ZINC, LEAD & SMELTING MADE OPERATING PROFIT DURING LAST QUARTER

Earnings of the American Zinc, Lead & Smelting Co. have been gradually improving. The company avoided red-ink figures in the last quarter, so far as actual operations were concerned. Whether or not any final profits will be shown depends to what extent inventories of metals are further written down. There has been a really satisfactory improvement in the trade position of zinc. Surplus stocks have been reduced from 91,000 tons in July to 67,000 tons on the first of December and the indication is the current month will see another reduction. This has made for a materially better feeling in the trade.

At its zinc-oxide plant at Columbus, Ohio, American Zinc has been getting splendid metallurgical results. While the capacity of this new plant was originally expected to be 7500 tons of zinc oxide annually, right now it is operating at only 50% capacity and is producing at the rate of 6000 tons per year. Output could be expanded to 12,000 tons of this tire and paint ingredient should conditions in the automobile trade demand it. This increase has been accomplished purely through recent metallurgical improvements and the working out of problems of production. At its Mascot mines in Tennessee the company has developed more ore than it has produced. There is developed in reserve to date sufficient ore to maintain capacity operations for many years on present known tonnages. The Mascot ore while relatively low grade is absolutely lead-free, which is so necessary in the manufacture of zinc oxide.

SIMON SILVER LEAD COMPANY SHIPS CONCENTRATE FROM MINA, NEVADA

The first carload of lead concentrate from the Simon Silver-Lead Mining Co.'s new mill, situated near Mina, Nevada, was delivered to the U. S. Smelter at Midvale, Utah, late in December. Zinc concentrate will go to the Harbor City plant near Los Angeles. A half interest in this zinc-oxide plant is owned by Dern & Thomas and M. P. Kirk, of Salt Lake City, and the other half by the Simon Silver-Lead company. Recently a four-day shut-down was made necessary to make adjustments to the electric-power line and to install a larger motor for operation of the flotation machines. Installation of a larger motor remedied what was said to be the only error made in planning the flotation plant. In all other departments the mill is reputed to be giving great satisfaction. Operating at capacity, it is estimated that the mill will have an output of 40 to 50 tons of concentrate per day. This product will be hauled to the railroad by the company's tractors with two trailers. The recently built road connecting the mine with the railroad is said to afford a good all-winter route for heavy hauling. Development work in the mine is to be extended in all directions, according to reports. Several discoveries of great significance have been reported as being made upon the fourth, sixth, and seventh levels, notably north and west. These developments, two of them made beyond the major faults, are of such importance that the management has started exploration of the new areas in anticipation of adding to the ore-reserves.

MINERAL PRODUCTION DURING 1921 IN BRITISH COLUMBIA

Though it has been decided that the usual Preliminary Review and Estimate of the Mineral Production of British Columbia will not be issued this year, on the ground of economy, the following official estimate of the mineral production for 1921 has been made. The production for 1920 is given for comparison.

	1920		1921	
	Quantity	Value	Quantity	Value
Gold, placer, oz.......	11,080	$221,600	....	$220,000
Gold, lode, oz.........	120,048	2,481,392	106,000	2,191,020
Silver, oz............	3,377,849	3,235,980	2,550,000	1,535,865
Copper, lb............	44,887,676	7,832,899	30,000,000	3,720,000
Lead, lb............	39,331,218	2,816,115	43,000,000	1,754,400
Zinc, lb............	47,208,268	3,077,979	45,000,000	1,723,500
Coal and coke, long tons	2,686,263	13,450,169	....	11,432,644
Miscellaneous and building material		2,426,950		1,976,460
		$35,543,084		$24,553,909

Taken as a whole and considering the low prices of base metals ruling throughout the year, the production cannot be considered as other than satisfactory. The gold output is disappointing, as it generally was expected that it would show an improvement on last year. The Rossland mines have produced more than 20,000 oz. over their production of last year. On the other hand, the Nickel Plate mine has produced nothing, and the Belmont-Surf Inlet mine shows a marked decrease; owing to labor trouble, the Premier mine, from which much was expected, has confined its attention mostly to construction and development work; it was only toward the end of the year that steady production commenced, and the great bulk of these shipments will obtain returns from the smelter too late to appear as 1921 production. The decrease in the silver production may be attributed to the complete collapse of the Slocan and Ainsworth districts, owing to there being no market for the output, and of the Dolly Varden mine, through financial difficulties. Except for a small production obtained as a by-product from the Rossland gold ores, the Granby has been the only company to produce copper during the year. The large lead and zinc production is remarkable.

GOLD PRODUCTION OF CALIFORNIA INCREASED DURING 1921

Preliminary estimates, based on reports gathered from all sections of the State, place the gold output of California at $16,000,000 for 1921, a distinct gain over 1920, when the gold yield totaled $14,311,043. Yuba was apparently the leading gold county, due to activities of nine dredges in the Yuba River field. Nevada county ranked second, and Amador third, with Calaveras and Sacramento close rivals for the fourth position. Statistics available indicate that the Yuba Consolidated Gold Fields, operating a fleet of gold dredges near Hammonton, was the leading gold producer of the State, with Natomas Consolidated, operating dredges in Butte and Sacramento counties probably holding second place.

First place among the quartz-gold producers is disputed by the Empire mine, at Grass Valley, and the Calaveras Consolidated, including the Morgan mine, near Carson Hill, Calaveras county. The Central Eureka, at Sutter Creek, Plymouth Consolidated, at Plymouth, North Star, at Grass Valley, and Argonaut, near Jackson, also ranked high in production of quartz-gold, with scores of lesser mines contributing important amounts of the yellow metal.

Silver production in California passed the $2,000,000 mark in 1921, the first time in the history of California that the output of the white metal ever exceeded $1,860,000, the latter figure being registered in 1920. San Bernardino was the principal silver county, with the California Rand the leading mine. Appreciable amounts of the silver also came from the mines of Inyo, Plumas, Nevada, Amador, Calaveras, and Shasta counties. The revival of gold mining was particularly notable in the final four months of the year, and the outlook is favorable for a decided increase in the gold output in 1922. Silver production is also expected to register a gain.

CONSTRUCTION ON NEW BRANCH RAILROAD IN CHIHUAHUA WILL COMMENCE

The firm of Dudley & Orr of El Paso has taken a contract for constructing 47 miles of grading and culvert work on the new Chihuahua and Oriente railroad, from Lucero, on the Mexican Central, to properties of the Erupcion Mining company and Ahumada Lead company, at whose expense the new line will be built and operated. J. C. Greenway, of Warren, Arizona, is president of the new railway organization and T. Hicklin of Ajo is chief engineer. D. Bruce Smith is general manager. Work is to be started within two weeks and is to be completed within 150 days. Operation is expected by next August. Traffic will amount to several hundred thousand tons of silver-lead ore, to be transported for reduction at El Paso and Chihuahua.

NEW DOLLARS READY FOR DISTRIBUTION

The first silver dollars of the new 1921 design were finished at the Philadelphia Mint on January 2, 1922. The coin, known as 'the peace dollar', has the head of liberty on one side and on the other a dove upon a mountain top, clutching an olive branch, struck by the rays of the sun, with the word 'peace' beneath it. This is the first change in the design of the dollar since 1878, officials say, and will remain as the design of the dollar for 25 years, unless changed by legislation. About 500,000 of the new dollars probably will be coined with the date 1921 and after that the dollar will carry the date of the year in which it is struck off. Efforts are being made to complete the coinage of at least a half million of the new dollars with the 1921 date in order to avoid a scarcity of the coin which would result in a premium being placed upon them by collectors. There will be in all about 180,000,000 dollars of the new design, officials say. Coinage of silver dollars ceased in 1904, when the silver purchases authorized by the Sherman Act had been completed, but it was resumed again in February 1921 when the purchase of silver was begun under the Pittman Act to replace the dollars melted and sold to the British government during the War.

WAGES OF MINE EMPLOYEES IN UTAH ARE CUT

A decrease in wages of 50 cents per shift was announced by nearly every metal-mining company in Utah on December 31, to become effective January 16, 1922. This decrease will affect employees of the Utah Copper, Utah Consolidated, and Utah-Apex companies at Bingham, although none of these companies is operating at present. A year ago wages were reduced from 75 cents to $1 per shift in practically every mining and smelting camp in the West. On May 1, 1921, operators in Arizona and New Mexico made a further cut, and the present action on the part of Utah operators is to equalize wage-scales more uniformly as between Western mining districts. On December 29, Montana operators announced a reduction of 50c. per shift, and the Nevada Consolidated Copper Co. at Ely has announced a reduction, calling for a maximum cut of 50c. per shift. In a statement issued to Utah Copper Co. employees, R. C. Gemmell, general manager, states that the time is approaching when the exhaustion of surplus metal stocks should make it possible for the company to market some new output, and that plans to that end are under consideration, although no definite, or even approximate date for such action, or the rate of production, can be designated at this time. He states that an important factor requiring adjustment is that of production costs, which at the time of suspension were so high that there would be no reasonable margin between them and the prices at which copper is now selling or is likely to sell for some time to come. Costs must accordingly be lower before resumption to any extent can be undertaken. The largest item of cost is payroll, and looking to decreases in this, as well as in all other possible directions, a revised scale of wages, as an economic necessity, is proposed, which it is believed will be acceptable to present and prospective employees, especially in view of the fact that the cost of living has decreased materially since production was discontinued last April. The maximum cut to be made by the Utah Copper is 50c. per shift.

JOHN D. RYAN GIVES REASONS FOR PROPOSED ACQUISITION OF AMERICAN BRASS CO. BY THE ANACONDA COPPER CO.

In a letter to stockholders, John D. Ryan, chairman of the Anaconda Copper Co., elucidates the motives of the directors in proposing to acquire control of the American Brass Co. He says:

"For several years past it has been increasingly apparent to the officers of the company that, in order to place the business of the company upon sound foundation, it would be necessary to acquire manufacturing and fabricating plants. It has been a growing conviction of the officers of the company that the large investment required to carry on the business of mining, smelting, and refining copper and zinc, was inadequately protected, and the business lacked a stabilizing influence so long as producers could not reach out to ultimate consumers of their product and take steps which it is believed must be taken if copper producers are to meet the competitive effort of the producers of other metals in marketing and distributing the same.

"The initial result of this conviction was the establishment of the wire-mill at Great Falls. The results achieved have demonstrated the wisdom of this step. Since the beginning of the operations of the wire-mill at Great Falls, on June 9, 1918, to the end of the current year, with December estimated, the wire-mill has drawn into rods and copper wire a total of 166,000,000 lb. of copper, which has been distributed at a manufacturing net profit of $850,000; the total investment having been $1,057,730, reduced to $885,000 after allowing for depreciation. When it became necessary last February to shut-down all mines of this company, as did also most of the other large producers on the hemisphere, necessity for acquiring such outlets for production was emphasized by the fact that the production of the wire-mill was sold ahead for many months, so that during practically the entire period of the shut-down it has been able to continue manufacturing and sale of rods and wire at a substantial manufacturing profit.

"About this time the officers of the company undertook an intensive study of the manufacturing and fabricating situation in the United States. An enumeration of the various plants engaged in such business, their geographical position with reference to facility for distribution, capacity for using metal, and general financial condition, was closely studied. Two propositions developed from this study:

"First—There were engaged in the United States, in the business of manufacturing and fabricating copper products from raw material, about 32 concerns of sufficient importance to be taken into consideration, and that the total capacity of these plants exceeded annually an output of 1,800,000,000 lb. of copper. As this capacity was considerably more than twice as much as had ever been required by the United States in pre-war years, and probably 80% more than has been required during the comparatively busy years, in the United States, of 1919 and 1920, respectively, and moreover, as it was found that a good many of the plants were well situated for distribution, modern in construction, and therefore could meet business requirements as well as plants which could be constructed, it became apparent that further building of plants would merely add to an already over-constructed mill capacity, and that an effort in this direction by your company would result in adding demoralization rather than stabilization to the situation.

"Second—The other proposition that became apparent was that the American Brass Co. dominated the manufacturing and fabricating situation in copper and brass.

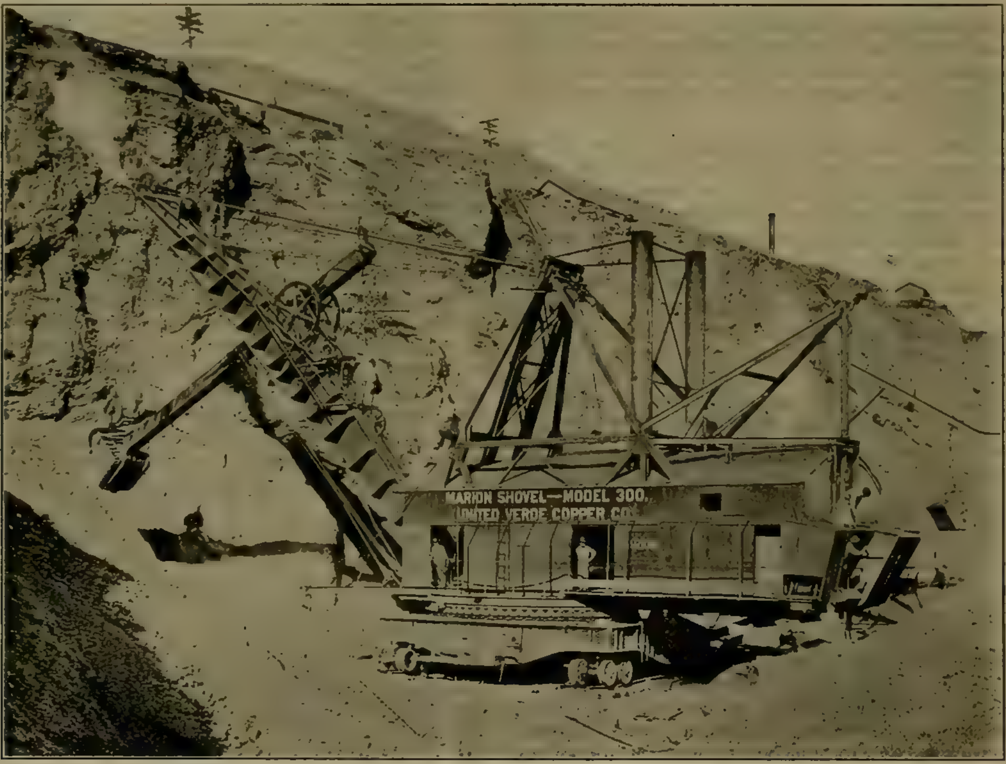
"Having become convinced that the desirable course to pursue, in view of the above situation, was to endeavor to acquire a control of American Brass Co., rather than to add demoralization to the situation by undertaking to become its competitor or to place this company in a position where it would be boycotted by other consumers and fabricators during the period of its attempt to build a fabricating business or through the acquisition of plants of more limited capacity, an experience which followed to some extent the entrance of this company into the wire business at Great Falls, it was decided to undertake negotiations along the foregoing line.

"During the present year, because of the inability of this company to market its copper and zinc output, the necessity was forced upon it to suspend operations, which it is estimated will cost $6,000,000. During this same period the plants of American Brass Co. have been operating upon a basis which, with the quota of this company of the sales of the Copper Export Association, would have enabled this

company to have produced 20,000,000 lb. of copper and at least 4,000,000 lb. of zinc per month during the entire period of the shut-down, without any accumulation of metal stocks. This would have enabled your company to have avoided the necessity for closing its plants, and resulted in the saving of the above shut-down expense, and would have been a stabilizing factor to the entire copper industry."

ARIZONA

Jerome.—An extension till March 10 has been made to the period within which stock of the Jerome-Verde Copper Co. may be exchanged for certificates of the Jerome-Verde Development Co. Those shareholders who fail to exchange will be given cash for their holdings, this in accordance with an agreement entered into with the United Verde Extension Copper Co., which now controls the Jerome-Verde ground and which is starting on its development from deep workings. Over 88% of the stock has been exchanged already.



Steam-Shovel Mining at the United Verde Mine at Jerome, Arizona

Based upon circumstances of a late visit of Charles W. Clark, general manager, there is belief here that one of the first copper properties to resume production in Arizona will be the United Verde. Mr. Clark is sure that copper will go to 15c. by February and stated that he would be satisfied at 16c. Federal and State taxation and high freight-rates he considers the main factors against operation in the spring, though there is some hope of better freight-tariffs on metals. ——The R. & H. property has been absorbed by the Howard Silver Co., which has been operating adjoining property for two years past. Development is reported such that a mill is being considered.

Kingman.—M. J. Kiley has been appointed receiver for the Schuylkill Mining Co., the mines of which are in the Chloride district. Several months ago Ralph Cole took over the properties for the total amount of the mortgage due Frank A. Garbutt. Some payments have been made by Cole, but he did not succeed in completely financing the property. The mortgage has now been foreclosed and the property advertised for sale.——Rich ore has been opened in the drifts on the 200-ft. level of the Nancy Lee. The finances of the company are in sufficiently good shape to carry through the present plan of development, which is extensive.

Prescott.—It is announced that D. M. Locey has taken over the Crown King, Wildflower, and Old Tiger mines in the Crown King district. The Crown King mine is one of the oldest and best known in that section of Arizona. Operations are to be commenced at once on the Crown King.

CALIFORNIA

Carrville.—John Lorenz has secured a lease on the Nash mine near the head of Coffee creek. The property is named for its original locator; at one time it produced much gold. Operations were discontinued because of the large boulders mixed with the gravel. It is understood that Lorenz will erect a wooden dredge to recover the gold. The first work will be to repair the road to the mine.

Genesee.—M. J. Calnan has purchased mining machinery that he will use to develop the Keystone group of claims, which he believes to be on the extension of the lode that passes through the Walker mine. Calnan has driven a 340-ft. adit from which he proposes to drive cross-cuts in both directions.

Grass Valley.—At the Alcalde mine the Bowery vein has been penetrated. There are good showings at various points. ——H. L. Ostrander, in charge of work at the Randolph mine, is developing the vein recently found.

San Francisco.—The directors of the California Metal and Mineral Producers Association, on December 28, elected the following officers for the ensuing year: Edwin Higgins, president; W. J. Loring, first vice-president; P. C. Knapp, second vice-president; W. G. Devereux, third vice-president; and Robert I. Kerr, secretary-treasurer.

COLORADO

Alma.—More activity is reported in progress in the Alma district than for many years past. Old mines with heavy production records, as well as prospects, are being re-opened and developed.

Aspen.—The Park Tunnel company is making progress with its new tramway to move ore to the mill, now being remodeled and modernized with flotation and cyanidation units. Many thousands of tons of milling ore is blocked out, and it is expected that with favorable terms offered many lessees will make money furnishing this ore for the mill. The capacity of the plant will be increased to meet this demand.

Boulder.—Increased activity is reported from the Caribou district and tonnage to the Boulder county mill at Cardinal is increasing accordingly. Operators in the Yellow Pine district report more men employed than for many years past, and advices from Salina state that the principal mines are shipping regularly and that new work is being started on sundry properties.

Cripple Creek.—The Vindicator Consolidated Gold Mining Co. is now cutting a station at 2100 ft. at the Vindicator No. 2 or main shaft, preparatory to cross-cutting west to the Lillie vein, that should be penetrated at a point about 30 ft. west. The vein dipped through the shaft in sinking the last lift; it carried high gold content. Twenty sets of lessees are operating in the upper levels of the Vindicator and Golden Cycle mines and the large majority are mining and shipping a good grade of ore. The Roosevelt tunnel is being extended at both ends by the Vindicator company and of about 3000 ft. required to make connection one-half has been completed. Rapid work has been done by the tunnel crews. The crew at the Portland end progressed 15 ft. daily during the first part of December.

The Ducey lessees on the Wilson of the Free Coinage group, Bull Hill, are mining two-ounce ore at the 125-ft. level of that old producer; they will have a shipment out by the middle of January. New machinery is being installed at the Victor mine, Bull Cliffs, to be operated by Math Korf of Cripple Creek and Eastern associates under a five-year lease. A long lease has also been secured on the properties of the Anona G. M. Co., formerly the Arvilla Tunnel & Mining Co., adjoining the Victor to the east.

Golden.—The annual short course for prospectors and practical mining men, offered by the Colorado School of Mines, will start on February 6 and conclude on March 4, 1922. A single fee of $10 is charged for the entire course, payable upon registration. All of the courses are of the most practical nature and compromise instruction relating to the common minerals, ores, and rocks; elementary chemistry, principles of ore dressing, assaying, and the more common metallurgical processes; methods of valuing, buying, and selling ore; lode mining; location of mining claims; and petroleum engineering. They are given entirely by regular members of the faculty and consist of lectures, supplemented by practical laboratory demonstrations. Address all correspondence to The Registrar, Colorado School of Mines, Golden, Colorado.

Silver Plume.—On the evening of December 26, the Burleigh mill of the Silver Plume Mining Co. was almost completely destroyed by fire. The origin of the fire is not definitely known, but is supposed to have been caused by defective wiring. The mill had been shut-down for a few days for repairs, the repairing had just been completed, and the mill was to have started on the morning of the 27th. Firemen were able to save the blacksmith shop and the machines in the machine-shop. The plant was formerly the property of the Tarkington Mines Co. and was part of the Dives-Pelican property. It has been handling about 100 tons per day from the Pelican dumps, using flotation and table concentration. The loss was partly covered by insurance, it is claimed. G. L. Cole is general manager for the company.

Silverton.—A recent shipment of ore from the Slide mine, in the Stony Pass section, returned $30 gold and $140 silver; the ore was mined from the tunnel. Work has been discontinued until spring.

IDAHO

Coeur d'Alene.—The Hecla Mining company has some ore in the Wide West claim, which the Hecla recently acquired from the Federal Mining & Smelting Co. in the settlement the two companies made of the Marsh litigation. It is reported that 1½ ft. of good ore is exposed at a depth of only 150 ft. and it is believed that with greater depth the vein will increase in size and value.

Progress at the rate of 300 ft. per month is being made in driving the tunnel to the Star mine. This tunnel will be 1½ miles long, 8 by 9 ft. in size, and is considered one of the engineering feats of the district. The enterprise was planned and is being carried on under the combined direction of the Hecla Mining Co.'s engineers and those of the Bunker Hill & Sullivan company. The cross-cut to tap the Star runs almost south from the Hecla shaft. Rapid progress in the tunnel is partly credited to the use of a mucking machine that loads a 2½-ton car in three minutes. The mucker operates on a track and is handled entirely by compressed air.

The Cedar Creek Mining & Developing Co. is developing properties on Granite creek. The main cross-cut is in about 3000 ft. In the main drift there is now shown 15 in. of lead-silver mill-ore. From this drift a cross-cut was started, and after going 55 ft. ran into two stringers of rich ore. These have been followed and are found to run almost parallel with the other ore-shoot. The two stringers have merged and now show 22 in. of ore, some of which assays 53% lead and 24 oz. silver.

Talache.—The Bluebird company has shipped from its mine on Blacktail mountain 420 sacks of high-grade silver ore. The owners expect to ship regularly.

MISSOURI

Joplin.—Approximately 13,800 tons of zinc ore were purchased in the Tri-State district during the last week of December, the price being $25 and $26. Lead ore was steady at $52.50. Production was about the same as for several weeks past. Shipments from the district were as follows:

Oklahoma mines: Blende, 13,347,660 lb.; value, $166,825; lead, 1,680,940 lb.; value, $44,100; total value, $210,925.

Kansas mines: Blende, 1,410,690 lb.; value, $17,625; lead, 460,650 lb.; value, $12,075; total value, $29,700.

Missouri mines: Blende, 1,259,690 lb.; value, $15,725.

Total for the district: Blende, 16,018,040 lb.; value, $200,175; lead, 2,141,590 lb.; value, $56,175; total value, $257,350.

Springfield.—Development of a copper mine in Benton county, Arkansas, is being pushed rapidly, according to information that has reached Springfield. The property is owned by the Page Mining & Smelting Co. of Ft. Smith, Arkansas, which company has leases on 570 acres, 11 miles east of Rogers. Assays of samples from various parts of the tract show, it is said, from 3 to 15% copper, with from $2 to $5 in gold and silver per ton of ore. The company has bought a 150-ton concentrating mill. The land under the lease lies along the White river.

NEVADA

Eureka.—The Eureka-Uncle Sam Mining Co. has acquired the old Hamburg mine, the negotiations being conducted by Frank T. Torpey. The Hamburg shipped sensationally rich ore during the early days. During the period from 1880 to 1894 the main shaft was sunk to a depth of 850 ft. and drifts and cross-cuts were run on four intermediate levels. A large amount of medium-grade ore is said to be exposed in the workings.

Oreana.—The Pershing County Mines Co., developing property in the Arabia district, has made final payment on the option which it exercised to purchase the old Montezuma mine, the second of the mines worked in the early 'sixties which this company has acquired. The Jersey mine, first taken over and developed by the company, has shown the ore not only to persist to depth but to increase in richness. Prior to opening the mines about 3000 tons of slag and tailing from the old plants was shipped to Utah, by the officials of the present company. Only the oxidized ores cropping at the surface have been extracted and reduced, and although much leached of silver, over $455,000 in silver alone was recovered from near the surface of the Montezuma claim. To reduce the ores of the Montezuma and Jersey mines to bullion, before the advent of the railroad, the first silver-lead smelter successfully operated west of the Mississippi river was constructed in 1865. Litigation closed the mines in the early 'seventies and they have not yet been explored below the 95-ft. level. Glenn D. Cook is manager.

Virginia City.—Concrete work being done by the United Comstock Mines Co. on American Flat is one-third complete and should be more than half finished by January 15. Rapid progress is made possible by the use of a 143-ft. tower which distributes 450 cu. yd. of concrete daily over a wide area. The largest single building is the cyanide plant, which is 290 by 330 ft. and is four stories high. The milling plant is expected to cost approximately $2,000,000 when completed. Additional structures are: lodging-house, mess-hall, office, boiler plant, pump-station, blacksmith-shop, machine-shop, compressor plant, heating plant, and superintendent's residence.

NEW MEXICO

Goldboro.—Sam Hidalgo, and A. H. Reynolds and T. E. Bartlett, both of El Paso, are mining ore from the new gold district, north-west of the Elephant Butte irrigation dam. ——Promising samples come from the 'Nigger Diggins', six miles west of Goldboro. The rock is high-grade silver ore.

Las Cruces.—High-grade shipping ore and mill-ore averaging 20 oz. silver over a width of 30 ft., not including four feet of horn-silver ore on the hanging side of the wall, which averages more than 50 oz. per ton, was opened on the 100-ft. level of the mine in Hidalgo county, according to an announcement by C. W. Mitchell, president of the Volcano Mines Co. He now has three cars of this ore ready for shipment to the El Paso smelter. Driving on the 100-ft. level in the north drift continues with three shifts. On the 200-ft. level he has opened ore that is 15 ft. wide. He is now sinking a winze on this orebody and have 15 tons of it on the dump. Timbering the shaft is under way from the 200- to the 300-ft. level. The face of the north drift on the 300-ft. level has the best showing in the mine. E. R. Ramsey, representing the Doyle company of New York, is at the Volcano mine, making plans for a cyanide plant of 100 tons daily capacity.

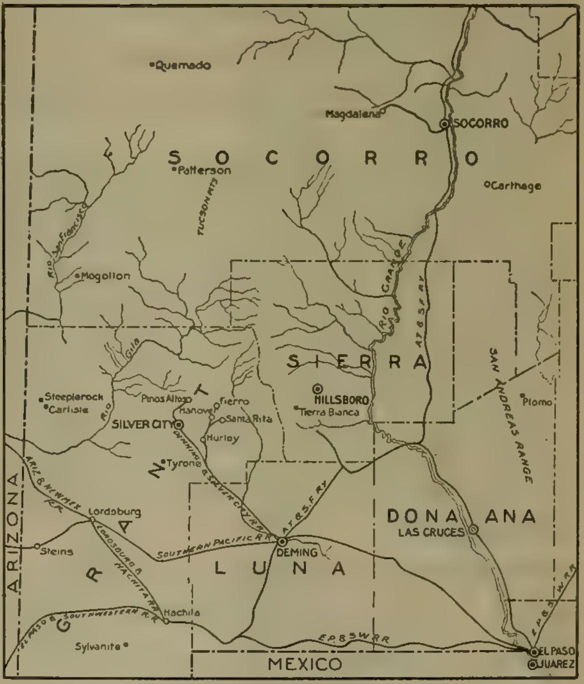
Lordsburg.—The Ruth property in the Lordsburg district has shown such improvement as to warrant continuing development. Frank G. Koerwer, manager, says that two drifts on the 60-ft. level show a width of 4½ ft. of ore.

OKLAHOMA

Picher.—A syndicate composed of the Mathiessen & Hegeler Zinc Co. and William Wrigley, Jr., of Chicago, are reported to have virtually closed a deal for the purchase of the Muncie, Blue Ribbon, and Homestead mines at a price said to be approximately a half-million dollars. The Muncie mine, just north of Treece, Kansas, at present is operated by Frank Childress of Galena and associates, under lease. The mill and 40-acre lease is controlled by S. C. Glover & Co., of Tulsa, Oklahoma, from whom Childress obtained the lease. Childress and R. L. Kidner of Kansas City have control of the Blue Ribbon mine property, which consists of a mill and 40 acres at Picher, Oklahoma. The Homestead mine at Baster Springs, Kansas, recently has been developed into one of the big producers of the district. Kidner and Childress also are the principal owners in this property.

OREGON

Gold Hill.—The Gold Coin Quartz and Placer Association, a local concern organized in the early part of the year, is developing mines in this vicinity. The association has been incorporated as the Gold Coin Mining Co. A. M. Knapp, of Medford, is at the head. The original Gold Coin group of mines, the Mohawk, the Alice, the Pearce groups, and the Red Ribbon have been acquired. In the Alice mine recent work on the vein has uncovered three ore-shoots of high-grade ore. The Gold Coin group is in the Jacksonville district; it is being further developed with a crew of 15 miners. This property has a contact vein approximately 15 ft. wide carrying gold. The Pearce group is rich placer ground on Poor Man's creek, four miles out from Jacksonville, consisting of 240 acres of virgin ground.



South-Western New Mexico

UTAH

Eureka.—The old Colorado mine has been closed down for some time past, except for a small amount of development which has been done on company account on the deeper levels. The results have not been favorable, and the work has been discontinued. Blocks of ground in the vicinity of old stopes have been leased, and numerous orebodies have been opened; the general result is that the mine, as a whole, is looking better than for many months past, according to

Hugh Trenholm, manager of mines for the Knight interests. At the Iron Blossom mine, prospecting has been done on the 1700 and 2200-ft. levels, but the results were disappointing and the work has been stopped.

Ore shipments for the week ending December 24 totaled 141 carloads, as compared with 156 for the previous week. The Tintic Standard shipped 42 cars; Chief Consolidated, 38; Colorado, 12; Iron Blossom, 11; Victoria, 11; Eagle & Blue Bell, 8; Swansea, 4; Empire Mines, 4; Dragon, 3; Gemini, 2; Sunbeam, 2; Gold Chain, 1; Centennial-Eureka, 1; Mammoth, 1.

Marysvale.—An orebody of considerable promise has been opened up in the I. X. L. property, about 7 miles from here, according to George E. Hemphill, manager for the American Consolidated Mines Co., which recently acquired the mine. At a point about 125 ft. from the portal, ore was found. At first it was 16 in. wide; it has increased to 2 ft. Average assays give returns of 57 oz. silver, 25% lead, and $2 in gold. One grab-sample assayed $5 in gold, 139 oz. silver, and 30% lead. The first shipment will be ready within 30 days. The property has been equipped with up-to-date mining machinery; it adjoins the Deer Trail mine, one of the largest gold-silver producers in the State.

Milford.—Mining has been active during recent months in Beaver county. At the property of the Galena Mining Co., 14 miles north-west of here, a tunnel is being driven to open up at depth a vein of high-grade ore, according to Frank L. Osborne, who is in charge of operations. Owing to the inaccessibility of the shaft, sinking has been discontinued. The tunnel has penetrated highly-mineralized vein matter, with bunches of 'steel' galena throughout the mass. Within another 100 ft., or about 440 ft. from the portal, Osborne believes the orebody will be struck.

Edward Bardgley, who is in charge of the Silver Independence company, announces that the company intends to deepen the shaft from the 100 to the 200-ft. level, and then cross-cut back to the fissure, which, in the upper workings, produced considerable ore. The company is installing a compressor, gasoline-engine, hoist, and machine-drills for this development work.

Park City.—It is reported that on the 1100 and 1500-ft. levels of the Ontario mine drifts are being run to prospect the eastern holdings of the company, with the expectation of cutting the rich Ontario vein that was cut by a porphyry dike, and which, undoubtedly, has been found recently in the Park-Utah property.——Work has been suspended, temperorally, in the long drift at the Park-Utah property that will have its outlet ultimately in Deer valley. A raise is now being made to connect with the Hawkeye shaft.——Ore shipments for the week ending December 24 totaled 2602 tons, as compared with 2430 tons for the preceding week. The Judge allied companies shipped 1452 tons; Silver King Coalition, 662; Ontario, 448.

BRITISH COLUMBIA

Alice Arm.—The Esperanza mine, which lies at an elevation of 800 ft. about one mile north of town, will ship approximately 100 tons of ore in the course of a few weeks. D. Jeremierson, of Vancouver, and associates, are the present owners of the property and it is their intention, providing the first shipment is a success, to continue the work during the winter.

Hazelton.—The Silver Standard mine, which has been closed for some 15 months, is to be re-opened at once; the mill will be thoroughly overhauled. Prior to the closing of the mine a new tunnel had been started to work the several orebodies more expeditiously, and in the driving of this a number of rich stringers were cut, the existence of which were not previously known. The tunnel has been driven 1000 ft. and, besides the rich stringers, three veins have been cut. The objective of the tunnel, the No. 4 vein, is about 400 ft. from the present face. W. G. Norrie-Lowenthal will again be in charge of the property.

Kaslo.—O. C. Thompson, who is in charge of development work on the Utica mine, states that much has been done in putting the mine in shape for operation. New ore has been blocked out and a car has been loaded ready for shipment.

Nelson.—W. G. Clark has developed a body of good ore at the Cody mine, in the Slocan district. There is a stringer of clean shipping ore and a good body of milling ore. Clark is making arrangements for the treating of the second-grade ore at a custom mill.——The Consolidated M. & S. Co. has issued a circular letter to the independent operators, making the following amendment to schedule 'D'; "Settlement: Payment will be made in full, shortly after sampling, to such shippers as select the spot settlement basis for lead. An advance payment will be made to those selecting the pooling system on the same basis as if they had selected the spot lead quotation, but less 25% of the net value of the lead. In this case there will be an adjustment when the lead value is finally ascertained in the operation of the pool". The new conditions that go into effect on January 1 have been made probably with a view to diverting a considerable amount of ore and concentrate to Trail that now is finding its way to the Bunker Hill & Sullivan smelter, at Kellogg. Owing to recent large sales the stock of lead is said to be below normal and the stock of spelter has been much reduced. The company now is in need of both lead and copper ores and concentrates. Recently Grant Hall and D. C. Coleman, of the C. P. R., and a number of well-known financial men visited the smelter. It is thought that the object of the visit may be in connection with the erection of the concentrating plant at the Sullivan mine.

Stewart.—Heavy snowfalls have stopped almost all mining activity in the Portland Canal district. Work continues, of course, on the Premier and such other properties as are well advanced in development and have made preparations for winter operations.——The aerial tram to the Silverado group has been completed and a considerable quantity of high-grade ore is to be sacked and shipped.

Vancouver.—The case brought by the Attorney-General of British Columbia against the general manager and engineer of the Britannia mine for criminal negligence in connection with the recent flood, when 36 people lost their lives, has been dismissed.

Victoria.—The Union Oil Co., of California, has purchased a site covering two acres at Esquimalt, and will spend $35,000 in the erection of a storage plant for its various grades of oils.——The Provincial government has leased one and a half acres of the old Indian reserve to the Shell Oil Co., which will proceed to erect a storage plant at once. The negotiations on behalf of the company were conducted by D. E. Fisher, divisional manager at Seattle.

MEXICO

Chihuahua.—In the Urique district William Erritt, of Hutchinson, Kansas, has taken over the Santa Teresa group of silver-lead mines, which consists of eighteen claims. He is preparing to install machinery and sink shafts with a view to increasing ore production.——It is announced by William White that large American financial interests have acquired the holdings of the Compañia Minera La Esperanza. The mines of this company are situated in the western part of the State of Chihuahua. They are well developed and in times past were producers of rich ore.——John Johnson, of Santa Rosa, has started extensive development work upon La Pizarra group of gold, silver, and lead mines. The property consists of six claims which are situated near Morelos.——El Coronel mines, situated in the Galena district, were recently acquired by John Wells of Sabinal, Texas. He is preparing to start development of the property.

ONTARIO

Cobalt.—During January the precious metal mines of Northern Ontario will distribute a total of $1,044,680 in dividends. The Nipissing is the only silver mine on the list, and its disbursement, including a 3% bonus, will amount to $360,000, the dividends of the gold companies being as follows: Hollinger, $246,000; McIntyre, $182,014; Wright-Hargreaves, $137,500; Dome Mines, $119,166.

Kirkland Lake.—The shaft on the Sylvanite is nearing a depth of 200 ft. The plan of operations is to sink to about 400 ft. before carrying on any extensive lateral work.——Exceptionally favorable results have recently been obtained at the 600-ft. level of the Lake Shore, where the extent and richness of the deposits appear greater than on the 400-ft. level. Development work is far ahead of milling requirements, and a large tonnage of high-grade ore is being accumulated in the stopes, pending an enlargement of the mill. The cost of all work is being paid from current profits.——At the Bidgood the vein which was 5 ft. wide on the 300-ft. level is reported to show a width of 21 ft. at the 400-ft. level; mineralization is well maintained.——The shaft of the Wright-Hargreaves is being sunk from its present depth of 400 ft. to deeper levels. Mill-heads are now averaging between $12 and $13 per ton, and the mill is treating over 170 tons daily. The orebodies have been found to widen with depth.

Porcupine.—The Dome Mines is negotiating for the purchase of the Foley-O'Brien adjoining the Dome Extension property on the north-east. Considerable work was done on this location some years ago with little result but the geological structure is regarded as favorable, as the porphyry rocks occurring on the Dome extend into the property.——The shaft on the Porcupine Paymaster will be put down from the present 200-ft. level to a depth of 400 ft. At that point a cross-cut will be driven across the orebody 98 ft. wide and a drift run along the centre of the deposit.——The Triplex has purchased a second-hand 20-stamp mill. It is stated that the 'paystreak' on the property has a width of 4 inches.

Obituary

Robert L. Jack, for many years Government Geologist in Queensland, and one of the leading economic geologists of the English-speaking world, died at Sydney, New South Wales, in November, at the age of 76. He was born in Scotland and went to Queensland in 1872.

Brant H. Engelke, 40 years of age, for a year past Chief Electrician to the United States Mining Co. at Bingham, Utah, was instantly killed on December 20 while in the act of repairing an electric wire. He had climbed to the top of a pole to make the repairs, when the pole fell, crushing Engelke to death. He came to Bingham from New York, four years ago, and became superintendent of the Silver Shield mine, which position he held until a year ago. He is survived by his wife and three children.

Charles Frederick Jennings, general purchasing agent for all companies controlled by D. C. Jackling and associates, died at St. Marks' Hospital in Salt Lake City on December 27, following an operation. He was born at Laramie, Wyoming, in 1873. In 1890 he was appointed storekeeper for the Union Pacific railway at Glenns Ferry, Idaho. In 1907 he was appointed purchasing agent for the Utah Copper Co. at Salt Lake City. Four years ago he was appointed general purchasing agent for that company and all other compnies under Mr. Jackling's general management. He was one of the most widely known purchasing agents in the West. He is survived by his wife, two sons, and three daughters. He leaves a large circle of friends, who deeply mourn his untimely death.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

R. Arthur Thomas was in Silesia recently.

C. A. Mitke has returned from South America.

A Henry Sinn, of Christiania, Norway, is in Paris.

W. Pellew-Harvey has returned to London from Australia.

Ralph S. J. Stokes has returned to Kimberley from London.

Robert A. Bryce is now at 8 Wellington street, East Toronto.

W. H. Johnston is with the Waihi company in New Zealand.

E. L. Jorgensen, of New York, is at Ilsenburg a Harz, in Germany.

H. Hardy Smith has returned from Korea to Sydney, Australia.

J. E. Bloom has moved from Brooklyn, New York, to San Francisco.

Afred de Ropp, Jr., of Wilmington, Delaware, is in San Francisco.

J. P. Porteus, of Lordsburg, New Mexico, was recently in San Francisco.

R. C. Gemmell spent a few days at Los Angeles and San Diego recently.

William T. McDonald, of the Phelps Dodge Corporation, is at Los Angeles.

Edwin T. Hodge has returned to Eugene, Oregon, from Vancouver, B. C.

Ezra B. Rider has moved from Bisbee, Arizona, to Hollywood, California.

George A. Camphuis has returned to Arivaca, Arizona, from Los Angeles.

G. Canning Barnard is leaving Etzatlan, Mexico, for South Africa, by way of England.

S. J. Speak is president elect of the Institution of Mining and Metallurgy, in London.

H. V. Burgard, formerly of Oakland, is making his home now at Hollywood, California.

Franklin W. Smith has returned to Bisbee from London. He is starting for Mexico forthwith.

R. G. Knickerbocker, metallurgical engineer, has returned from South Africa to Rolla, Missouri.

A. J. Baudette has returned to Los Angeles from a protracted tour of inspection in Colombia.

Theodore Hollingsworth has moved from Newton Center, Massachusetts, to Glendale, California.

Dwight L. Sawyer, of Salt Lake City, has become geologist for the Minas de Matahambre, in Cuba.

W. H. Wellman is now superintendent for the Metatas Mining Co., at Mazatlan, Sinaloa, Mexico.

Morton Webber was recently at Douglas, Arizona, and is now in Mexico, with **W. T. Benson** as assistant.

J. A. McDougall, of the mechanical department of the Phelps Dodge Corporation is now at Bisbee, Arizona.

Arthur Moline, of the Bendigo Amalgamated Goldfields, has returned to Bendigo after journeys to the United States and South Africa.

H. A. Tobelmann, recently metallurgist at the Ajo plant of the New Cornelia Copper Co., is now on the personal staff of **George C. Beach**, in New York.

Charles W. Goodale has been awarded the gold medal of the Mining and Metallurgical Society of America, for "distinguished service in increasing the safety of men in mining and metallurgical operations". It will be presented to him at a meeting of the society to be held in New York on January 10.

THE METAL MARKET

METAL PRICES

San Francisco, January 3

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6.25— 8.25
Copper, electrolytic, cents per pound	14.75—15.25
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$84
Platinum, 10% iridium, per ounce	$95
Zinc, slab, cents per pound	6.75— 7.75
Zinc-dust, cents per pound	9.50—10.00

EASTERN METAL MARKET

(By wire from New York)

January 2.—Copper is quiet and strong. Lead is inactive and steady. Zinc is dull but firm.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Dec.	27	64.75	Holiday	Nov.	21	68.54	38.33
"	28	65.00	35.12	"	28	67.55	37.85
"	29	65.00	35.12	Dec.	5	67.27	37.35
"	30	64.75	34.75	"	12	65.46	35.44
"	31	64.62	34.62	"	19	66.08	35.60
Jan.	1 Sunday			"	26	65.50	35.25
"	2 Holiday			Jan.	2	64.82	34.90

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	68.24
June	110.50	90.84	58.51	Dec.	131.92	64.78	65.76

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Dec.	27	13.62	Nov.	21	13.19
"	28	13.62	"	28	13.35
"	29	13.62	Dec.	5	13.39
"	30	13.62	"	12	13.46
"	31	13.62	"	19	13.58
Jan.	1 Sunday		"	26	13.62
"	2 Holiday		Jan.	2	13.62

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	13.54

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Dec.	27	4.70	Nov.	21	4.70
"	28	4.70	"	28	4.70
"	29	4.70	Dec.	5	4.70
"	30	4.70	"	12	4.70
"	31	4.70	"	19	4.70
Jan.	1 Sunday		"	26	4.70
"	2 Holiday		Jan.	2	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	4.70

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Dec.	27	5.17	Nov.	21	5.18
"	28	5.15	"	28	5.14
"	29	5.15	Dec.	5	5.23
"	30	5.20	"	12	5.31
"	31	5.20	"	19	5.19
Jan.	1 Sunday		"	26	5.23
"	2 Holiday		Jan.	2	5.17

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5 09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	5.24

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Dec.	6	46.00	Dec.	20	52.00
"	13	52.00	"	27	48.00
			Jan.	3	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	40.40
June	94.40	85.00	49.50	Dec.	95.00	52.50	49.50

REVIEW OF U. S. FOREIGN TRADE IN 1921

Foreign trade figures of the United States in the calendar year 1921 show a heavy reduction in the stated value of the merchandise entering and leaving the country. In no single year in the history of our foreign trade, says the 'Trade Record' of the National City Bank of New York, have the official figures shown such a percentage of reduction. The total foreign trade of the country, imports and exports combined, stood at 13½ billion dollars in the calendar year 1920, the highest total ever reached, and 11 months figures, ending with November 1921, justify the assertion that the total for the full year just ending will not exceed $7,000,000,000, and will probably fall a little below that total, as against 13½ billion dollars one year earlier.

The reduction in the total value of the merchandise entering and leaving the country in 1921 will be about 48%: in imports the reduction will be approximately 53% and in exports 45%. This falling off in the value of the foreign trade in 1921, when compared with 1920, extends to every great group of articles, both in imports and exports. Raw manufacturing material imported shows a falling off of about 53% in total value, foodstuffs 63%, and manufactures 43%, these figures being, of course, in very round terms, the smaller reduction in manufactures being due to the fact that importers are bringing in large quantities of manufactures in anticipation of a higher tariff. On the export side, manufacturing material shows a fall of 48%, foodstuffs 33%, and manufactures 51%, these figures as to exports being also necessarily in very round terms.

Considering the trade of the country with the grand divisions, imports from Europe show a fall of 38%, from North America 54%, from South America 64%, and from Asia and Oceania 58%. Exports to Europe show a decline of 45%, to North America 40%, to South America 56%, and to Asia and Oceania 39%.

The general causes of this tremendous decline in the value of every group of articles imported or exported and also a reduction in the trade with every grand division of the world, lie primarily in the fact that the prices per unit of quantity are, in most of the important articles, less than half those of a year ago and that, in many instances, a given quantity of merchandise being now imported is valued at less than half that at the same date last year. Our biggest imports are, of course, in manufacturing materials—india rubber, hides and skins, wool, raw silk, raw cotton, fibres, and tin. The rubber imported in October 1921 entered at 14c. per pound, against 37c. in the same month of last year; cattle hides at 10½c. per pound, against 22c.; carding wool at 14c. per pound, against 40c. a year ago. The falling off in values of the principal articles exported is equally striking and an equally important factor in the causes of the decline, wheat, for example, exported in November going at $1.18 per bushel, as against $2.60 in November of last year.

Of course, adds the bank's statement, these big reductions in the values per unit of quantity of the articles imported and exported are not the only causes of the big falling off, for there are many actual reductions in quantities, and this is due to the decreased purchasing power of our own farmers and wage-earners and also to the big reduction in the imports of the countries to which our exports are sent.

MONEY AND EXCHANGE

Foreign quotations on January 3 are as follows:

Sterling, dollars:	Cable	4.21
	Demand	4.21½
Franc, cents:	Cable	8.08
	Demand	8.10
Lira, cents:	Demand	4.30
Mark, cent:		0.58

Eastern Metal Market

New York, December 28.

An optimistic tone pervades all the markets as the year draws to an end and the price-trend in nearly all of them is firm to higher.

Buying of copper has slackened but the volume of inquiries is good. Prices are very firm.

The tin market is temporarily inactive with prices slightly lower at firm unchanged prices.

Demand for lead is quiet and steady at firm unchanged prices.

Buying of zinc is very light and prices are a little easier.

IRON AND STEEL

Encouraging activity in pig-iron in several centres marks the end of the year. In steel, there is reduced demand, accounted for by deferring of deliveries until after January 1. The buying of pig-iron has been at the expense of prices, but so far as that goes the year-end shows an average for steel prices, not merely the lowest of the year but lower than at any time since January 1916.

The new year is promising, says 'The Iron Age', at the outset chiefly in continued activity in construction lines and also in a sustained demand for pipe and tin plate. By January 15 a definite betterment in mill-operations is expected. Operations generally now average not over 30%.

The composite price for finished steel is now 2.062c. per pound. The pig-iron figure, $18.68, is lower than any other for the year, with the sole exception of that ($18.51½) for August 9. These two figures are the lowest since September 1916.

COPPER

Actual business, as the year closes, is light but the volume of inquiry keeps up and the strength of the market is pronounced. Optimism prevails and prices, while unchanged, are decidedly firm. The chief feature is the prospect of a scarcity of metal developing, should the rate of demand keep up which has characterized recent weeks. Mining operations have not been over 40% of capacity for the greater part of the year and though preparations for more active mining are under way it will consume considerable time before the effect in output is appreciable. Prices are unchanged for electrolytic copper at 13.87½c., delivered, or 13.62½c., New York or refinery, for early delivery with first quarter at 14c., delivered, or 13.75c. refinery. Some producers are out of the market at these levels. Foreign business continues in satisfactory volume.

TIN

There has been almost an entire absence of business the past week, with dealers and consumers doing no buying. Some dealers have been making offerings at prices under the market, but their object has been clouded in doubt as no sales resulted, buyers not being eager to accept any offerings of any kind. The London market has been closed from Friday to Tuesday, inclusive. Spot Straits tin yesterday was quoted largely nominal at 32.75c., New York, having declined from 33c. a week ago. Arrivals thus far this month have been 3635 tons with 4765 tons afloat. The London market on Friday was but slightly under the prices prevailing a week ago.

LEAD

Demand continues fully equal to consumption and no weakness in the market is anywhere perceptible. Prices are firm at 4.70 to 4.75c., New York, and 4.35 to 4.40c., St. Louis, in the outside market, with the leading producer still quoting 4.70c., New York and St. Louis. Demand for January delivery is larger than normal at this time. It is quite generally expected that export business with Europe may develop early next year.

ZINC

Prime Western for early or 30-day delivery is slightly easier, due to light offerings of one or two weak holders, but the volume obtainable is small. This makes the market about 4.82½c., St. Louis, or 5.17½c., New York, with first quarter about 4.95 to 5c., St. Louis, or 5.30 to 5.35c., New York. Producers are not pressing for sales, but are adopting a waiting attitude, some not selling at all except to regular customers. There are indications of exports to England developing, due partly to increased expansion there in galvanized-sheet making, particularly for export.

ANTIMONY

In a very dull market prices are unchanged at 4.50c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

While the leading producer continues to quote virgin metal, 98 to 99% pure, in wholesale lots for early delivery at 19c. f.o.b. plant, it is generally understood to be meeting the quotations of importers of 17 to 18c., New York, for the small business offered.

ORES

Tungsten: No change is recorded and the market continues inactive and nominal at $2 per unit and higher, depending on the grade of ore and the quantity and delivery.

Molybdenum: Quotations continue nominal at 45 to 50c. per pound of MoS_2 in regular concentrates containing 85% MoS_2.

Manganese: No interest from consumers is reported and quotations remain nominal at 20c. per unit, seaboard.

Chrome: Stocks are ample and there is therefore no demand from consumers. Nominal quotations are $20 to $28 per net ton, c.i.f. Atlantic ports, depending on the grade, etc.

FERRO-ALLOYS

Ferro-manganese: Actual sales in the past week have been confined to carload lots at $58.35, seaboard. The inquiries last week of about 600 tons have not resulted in orders, so far as ascertainable.

Spiegeleisen: Sales of small lots are reported at prevailing quotations of $26, furnace, for the 20% grade. Inquiry is light.

Ferro-tungsten: There is no business reported and prices are nominal at 40 to 45c. per pound of contained tungsten in the domestic alloy. The foreign product is quoted at 50c., seaboard.

Ferro-silicon: The 50% alloy is available at $55 to $57 per ton, delivered, with moderate sales reported. Buyers are ordering small lots only as they need them.

Ferro-chromium: Standard American alloy is quoted at 11 to 14c. per pound, delivered, depending on the grade and composition. There is no demand.

Harry H. Smith, of Tulsa, Oklahoma, representing the Mid-Continent Oil and Gas Association and the National Association of Independent Oil Producers, asked the Senate Finance Committee to put a duty on crude and refined oil to protect the industry in this country. He said that many large deposits of oil in Mexico and South America would be developed in the next few years. At present the principal importations come from Mexico, where the cost of production is $1 per barrel less than here. He said that there were one million persons employed in producing oil in this country and over $3,000,000,000 was invested.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.00 to 1.50
“ “ “ “ “ carboys “	2.00 to 2.75
“ “ C. P., 9-lb. bottles, in barrels, per pound	0.23½
“ “ “ bulk, in carboys, per pound	0.18½
“ muriatic, com'l, in carboys, per 100 lb	2.25 to 3.25
“ “ C. P., 6-lb. bottles, in barrels, per pound	0.28½
“ “ “ bulk, in carboys, per pound	0.22½
“ nitric, com'l, in carboys, per 100 lb	7.25 to 8.25
“ “ C. P., 7-lb. bottles, in barrels, per pound	0.38
“ “ “ bulk, in carboys, per pound	0.27¾
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.25 to 6.00
“ powdered, in barrels “	5.50 to 6.50
“ glass, ground, 30 mesh, cases, tin lined, per 100 lb	16.50 to 17.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	27 to 37
Lead acetate, brown, broken casks, per 100 lb	16.00
“ “ white “ “ “	19.00
“ “ “ crystals, per pound	0.20
“ C. P., test., granulated, per 100 lb	17.50
“ “ sheet, per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
“ com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per lb	0.08¾
Manganese di-oxide, bulk, Caucasian (85% MnO_2, – ¾% Fe), in casks, per ton	60.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.14½
“ “ “ “ granular “ “	0.15
“ “ “ “ powdered “ “	0.17½
“ carbonate, calcined, in barrel lots, per lb	0.09 to 0.12
“ permanganate, in drums, per pound	0.40
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in sacks, per 100 lb	2.50 to 3.00
“ “ “ in barrels “	3.00 to 3.50
“ bicarbonate of “ “	2.75 to 3.50
“ caustic, ground, 98% “ “	5.25 to 6.00
“ “ solid “ “ “	4.30 to 4.75

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	375.00
Conduit, galvanized iron, ¾-in., per 100 ft	10.35
“ “ “ 2-in. “	32.55
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	18.70
“ “ “ 10, triple-braid, weather-proof, coil lots, per 100 lb.	21.00
“ “ “ 14, single-braid, rubber-covered “ per 1000 ft.	7.80
Insulators, glass for telephone, No. 9 pony, per 1000	86.50
“ “ power, No. 14, per 1000	103.00
“ porcelain, 6600 v., No. 44, per 100	19.30
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
“ “ “ “ solid, per 1000	20.20
“ “ “ 3½ “ “	69.20
“ tubes, 5/16 by 3-in. “	9.05
“ “ ½ “ 6-in. “	38.15
Sockets, weather-proof, molded, No. 60,666, per 100	27.60
Telephone wire, iron, size 12, half-mile lots, per 100 lb	8.75

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	17.06
“ “ electric, 6-ft., No. 6, in lots of 1000, per box of 100.	8.73
Blasting-powder, “B” soda, in 100-keg lots, per keg of 25 lb	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	19.00
“ gelatine “ “ “	19.00
“ ammonia “ “ “	18.00
Fuse, common, in case lots, per 1000 ft	7.22
“ waterproof, triple tape, in case lots, per 1000 ft	9.01

FUELS

Coal, Utah steam, $3.50 at mine, plus $7.25 freight to California terminal points, in carload lots, per ton	10.75
Coal, blacksmith's, in carload lots, per ton	21.00
“ “ in small lots, per ton	24.00
Coke, in carload lots, per ton	25.00
Fuel oil, per barrel	1.50
Diesel oil, per gallon	0.06
Distillate “ “	0.16½
Gasoline “ “	0.22½

HARDWARE

Anti-friction metal, per pound	0.16
Babbitt, genuine “	0.42½
Brass sheets, half-hard and soft, per pound	0.24½
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
“ solid “ “ “	0.11
Fish-plate bolts, ⅜ by 2-in., per 100 lb	7.90
Nails and spikes (20d to 60d base), per keg	4.50
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb	9.45
“ cold punched “ “	11.25
Picks, mining, 5-lb., per dozen	12.00
Shovels, carbon steel, No. 2, long handles, per dozen	15.00
Track spikes, ⅜ by 4-in., per 100 lb	4.65

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	3.50
Rails, steel, 16-lb., per 100 lb	3.69
Reinforcing-steel, per 100 lb	3.50
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	6.40
“ flat “ “ “ “	6.30
“ flat, black iron “ “	5.65
Structural T's, channels, angles, and beams “	3.60

A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.

Bars, steel, square, cold-rolled, per 100 lb	6.25
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	12.40
“ “ galvanized “ “	15.70
“ “ black “ 4-in. “	52.45
“ “ “ extra strong “ “	95.25
Shafting, cold-rolled (2¼ to 3-in. base) “	4.90

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 22½%; extra strong cast-steel, 30%; plow-steel, 35%; blue-centre steel, 20%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot	0.40
Cast-steel rope, per foot	0.24
“ “ extra strong, per foot	0.26
Plow-steel rope, per foot	0.28

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	75.00
Fir, common, base price, per M	28.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	34.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	45.00 and 50.00
“ clear, 1 to 2 in. thick, up to 12 in. wide, per M	90.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	80.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	200.00
White pine “ “ “ “	150.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case	6.10
Carbide, in 100-lb cans, per can	7.75
Cotton waste, best grade, per 100 lb	14.50
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.17
“ “ “ 2 (standard), per pound	0.16
Packing, flax, per pound	0.33 to 0.85
“ sheet “	0.25 to 1.00
“ steam or water, first grade, per pound	0.90
Silex lining, crated, per long ton	41.00
Tube-mill pebbles, Danish, selected (in bags), per long ton	32.00
Zinc-dust, in 250-lb. boxes, per 100 lb	9.50
“ sheet, 36 in. by 84 in., No. 9 gauge, in ton lots, per 100 lb	13.50

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Fire-brick, clay, per 1000, in carload lots, Livermore Star Brand	55.75
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb	2.65
Portland cement, in bags, per barrel of 380 lb	3.94

Allowance of 15c. for bags returned in good condition.

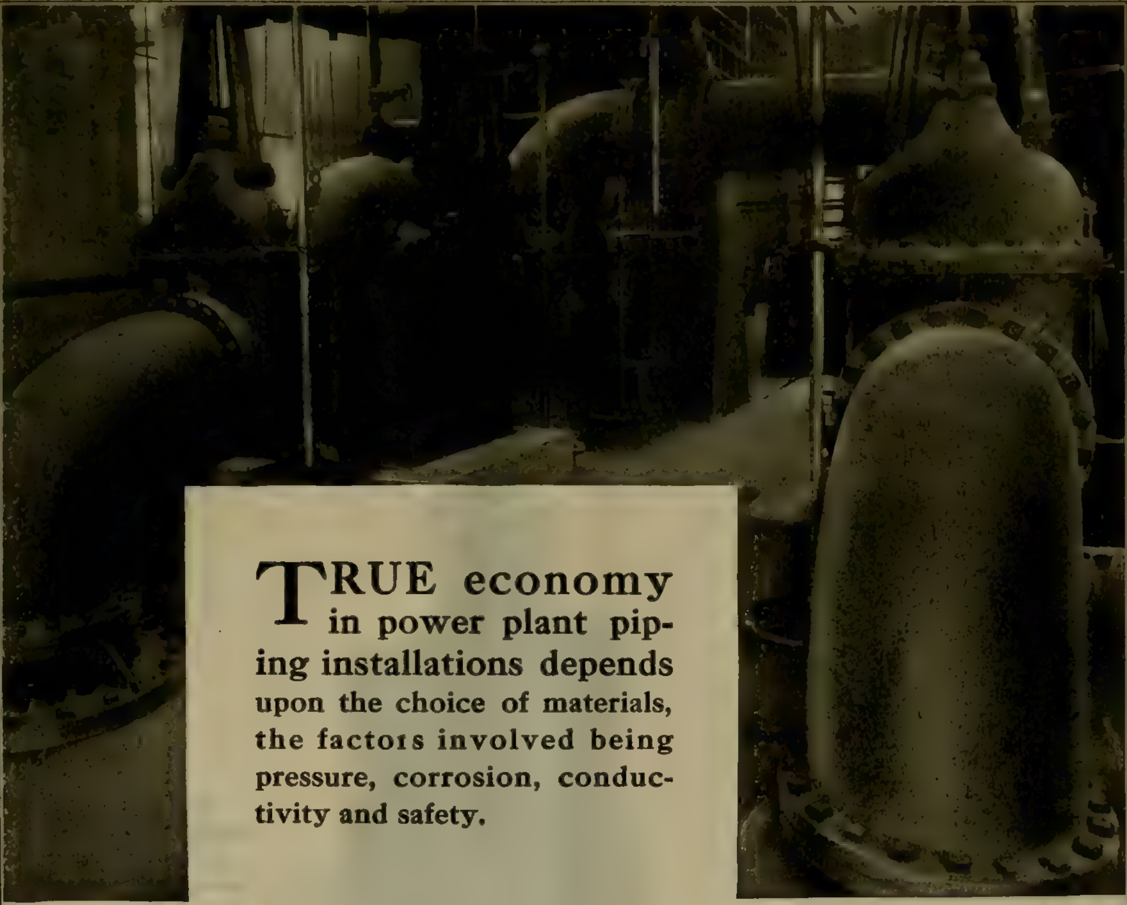
Portland cement, in barrels, per barrel of 400 lb	4.54

A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	$20 to $2500
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	10 to 15
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, powdered, per pound	3c. to 6c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	20 to 25
Mica, according to size, clearness, and cleavage, per pound	1 to 8
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, ground, commercial, per ton	24 to 26
Tin ore, not less than 60% Sn, per % Sn	4 to 6
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00



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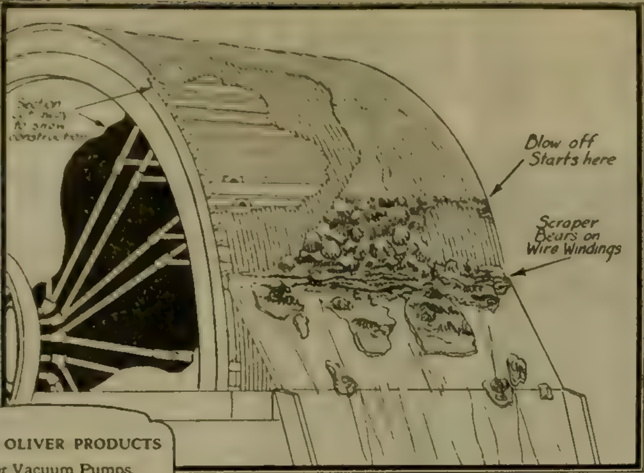

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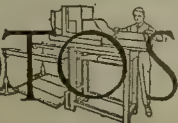

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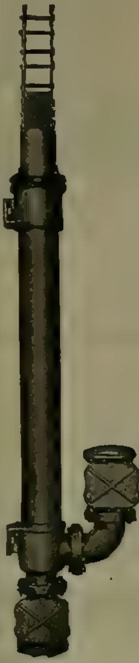

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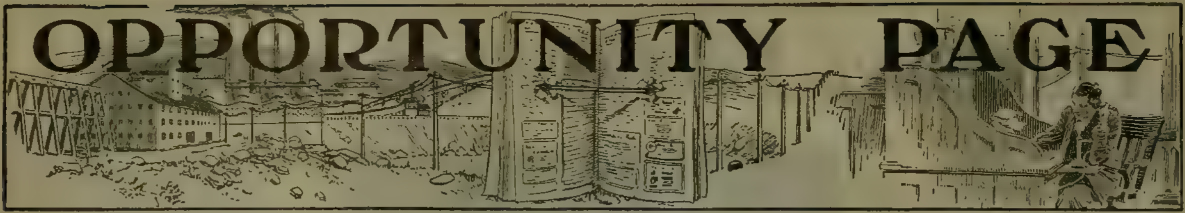

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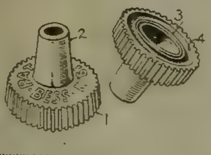

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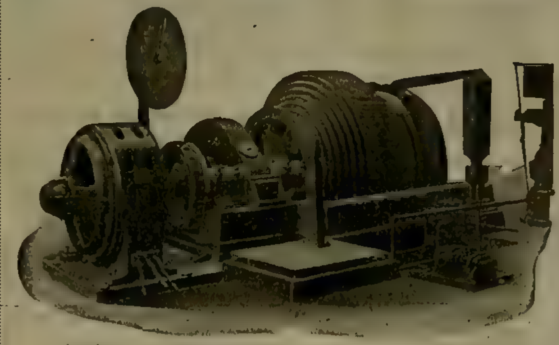

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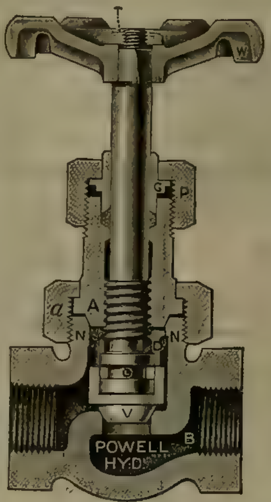

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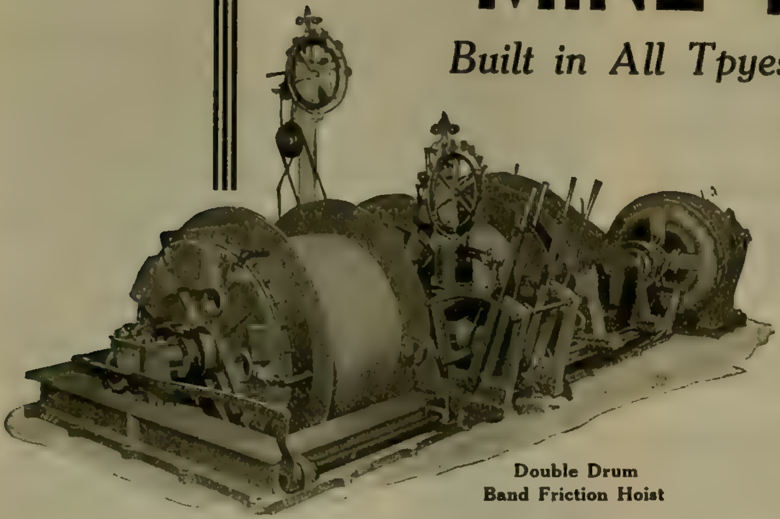

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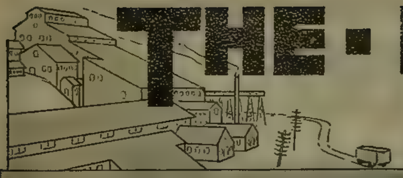

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Bullard, E. D.

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Sullivan Machinery Co.

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Ingersoll-Rand Co.
Sullivan Machinery Co.

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Denver Engineering Works Co.
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Morse Bros. Machy. & Supply Co.
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Gears, Herringbone
Fawcus Machine Co.

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General Electric Co.
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Westinghouse Elec. & Mfg. Co.

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Dixon Crucible Co., Joseph

Grinders, Laboratory
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Caire Co., Justinian
Calkins Co.
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Hardinge Co.

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Chicago Pneumatic Tool Co.
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Simpson Co., A. H.
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Denver Rock Drill Mfg. Co.
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Ingersoll-Rand Co.
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Lidgerwood Mfg. Co.
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(Continued on page 36)

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Tube-Mills (see 'Mills')

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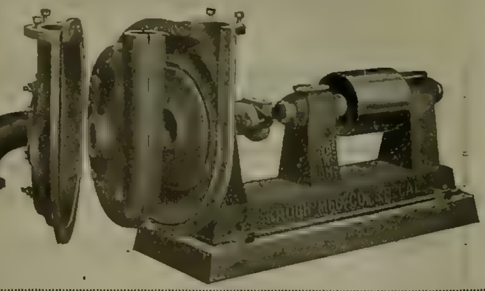

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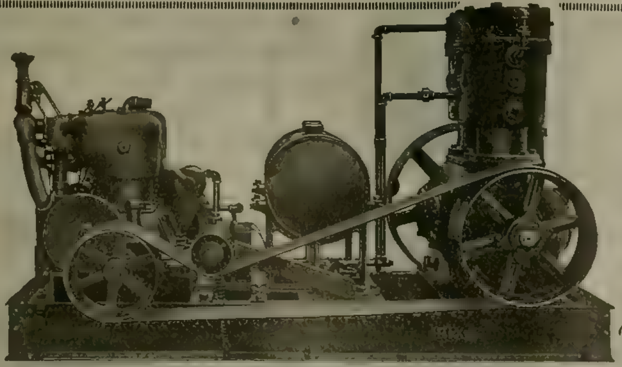
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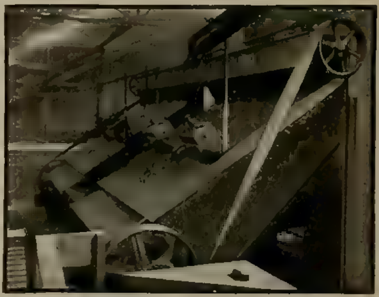

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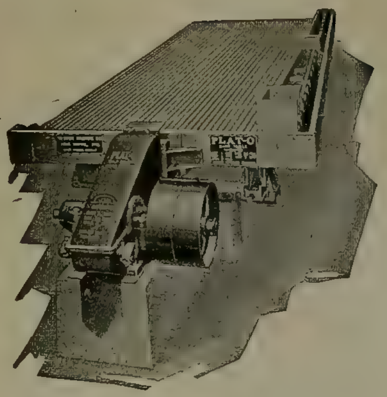

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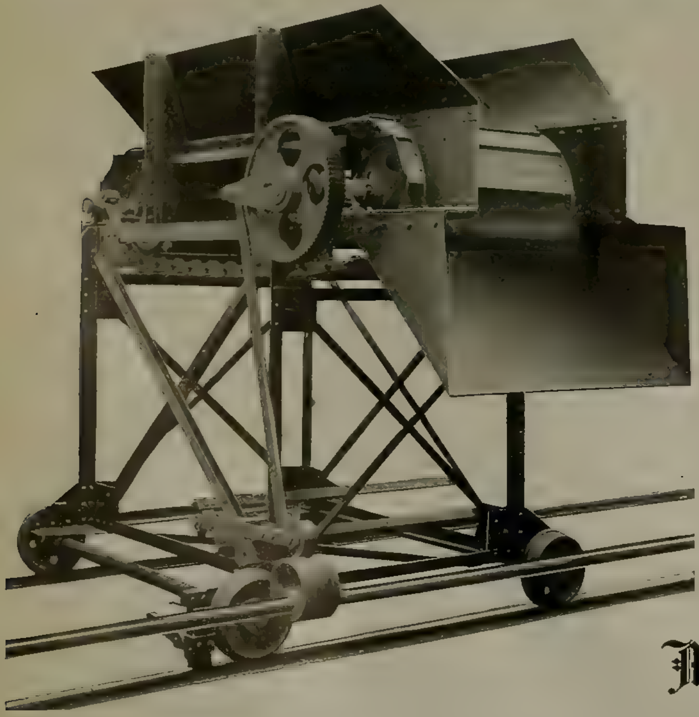

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T. A. RICKARD, ... Editor

SOVIET Russia is to be commended for the bold step, recently taken by the Peoples Commissars, providing for the legalization of metric measures in that country. From consular sources it is learned that the law provides that, after 1923, the metric system of weights and measures must be adopted throughout soviet Russia. As with the introduction of decimal coinage into the United States, the first step in making such a reform appears to be drastic; but after a few years the change is recognized as one that is indispensable to national progress.

UNSECURED paper currency invariably causes an interruption to international commerce. The Government currency notes of Great Britain are not exchangeable on demand for gold; consequently, the recent reduction of the amount in circulation was doubtless a factor that affected favorably the rate of exchange between London and New York. The present rate of $4.20 is in marked contrast to that of January 1921, when the paper pound was worth only $3.53. The improvement has been gradual and steady, and has continued in spite of the recent importation into Great Britain of large quantities of grain and cotton from the United States. The increasing stability of exchange quotations across the Atlantic is significant, and will do much to restore confidence in the expectation of a resumption of normal exportation.

A DECISION adopted at the third session of the International Labor Conference of the League of Nations, recently held at Geneva, that the use of white lead for interior painting shall be prohibited after the lapse of six years, indicates a somewhat mistaken view as to the cause of sickness among artisans engaged in such work. However, indoor artists are still to be allowed to continue their professional work without interference as to the composition of the pigments they may use, and a few other concessions have been granted. It appears that, after the lapse of the stipulated period, no persons under 18 years of age will be permitted to use an industrial paint containing white lead or lead sulphate, unless he or she be an apprentice. The explanation of this ruling is not clear. If lead paint be harmful, why should apprentices be exposed to its ill effects? After January 1, 1924, no paints containing lead can be mixed from dry ingredients by the painters; measures are to be taken to minimize the ill effects arising from a lack of care in the use of spraying apparatus; and the danger of inhalation of the dust that is disseminated during the process of 'rubbing down' old paint must be obviated by protective measures. These recommendations are sound and logical; had their significance been anticipated by the introduction of preventive measures in the past, no need would arise now for the drastic proposals made by the Labor Conference in regard to the abolition of the use, for interior painting, of pigments containing lead.

THE annual demand note for the $15 yearly dues from members of the Institute states that $5 is to be applied as a subscription to the magazine 'Mining & Metallurgy', and that this represents a nominal division of the receipts to comply with post-office regulations. It is interesting to learn that a nominal 'value' has been assigned to that publication, and that it averages about 40 cents per copy; we wonder how many members would prefer to forego the privilege of supporting the Institute's new excursion into the publishing business if by so doing their dues were reduced to the extent of $5 per annum. Unfortunately for them they have no choice. The publication was wished upon them by the authorities at headquarters; and they now read that the subscription is obligatory. The idea of a "subscription" being "obligatory" is strange; it has a touch of caustic humor; the sentiment underlying the intimation indicates the lack of a desire to study the wishes of members or to respect the position the technical press has won for itself after many years of endeavor.

PROPAGANDISTS often give the dear public credit for an exceedingly small amount of horse sense. For instance, the Educational Service Bureau of the American Railway Express Company, quoting Mr. George C. Taylor, its president, felicitates the public because, by virtue of the new Revenue Act that became effective on January 1, it (the public) will "save approximately $1,500,000 per month as a result of the elimination of the Federal war-tax on express shipments". The sum collected during 1920 was $17,502,918. On the same theory, if all Federal taxes were abolished the public could 'save' four or five billion dollars in the next year. The only way to save is by decreasing expenditures, not by shifting the source of revenue. It matters not at all whether a man pays with a coin out of his vest pocket, with a bill out of his trousers, or writes his check from the book that he carries in his coat. To save he must stop buying things that do him no good. Mr. Dawes—if Congress will let him—will save something under a billion; Mr. Taylor merely draws attention to the fact that a little more cash will come from the collective trousers than from the vest.

CONTRIBUTIONS to 'Discussion' this week start with a letter from Mr. Robert B. Brinsmade, who writes from Mexico on the subject of militarism as affected by the gain of huge fortunes by the captains of industry. We welcome Mr. Brinsmade's discovery of one more objection to militarism, for the sooner the modern world rids itself of such brutality the better for humanity. The note on ball-mills is by an engineer, Mr. P. R. Hines, well qualified to speak on the subject. Mr. W. G. Emminger writes from Rochester, Nevada, to record his experience in the use of lime in the cyaniding of silver ores. Mr. von Bernewitz contributes a note on the so-called gold premium in England. We ventured to insert the word "paper" before "pound sterling" in the 13th line of his letter as printed, because it is essential to keep in mind the difference between the gold sovereign and the paper pound. Of this Mr. von Bernewitz, of course, is aware, but it is a fact that cannot be emphasized too much in discussing the 'premium'. Mr. M. G. F. Söhnlein sends a welcome bit of commentary on the use of the Spanish term 'cajon'; and our friend Professor McDonald has something interesting to say on the definition of 'engineer'. Our own idea of an 'engineer' is stated in the address delivered at Rolla and appearing in our issue of December 10.

CARD-INDEXING of books published is an essential feature of library economy, but few engineers appreciate the fact that they can maintain such a system of their own at a negligible expense. The Library of Congress at Washington has developed the idea of co-operative cataloguing that was started by the American Library Association in 1876. The printing and storing of cards was begun in 1898; and in 1901 the work of distribution was commenced. Most of our readers are familiar with the style adopted; the standard Library of Congress cards are to be found in almost all American libraries. One form of card only is printed for each book. The author's name is given in full, dates of birth and death being added when available. The title is usually given in full, and details follow that describe accurately the contents of the volume. All the cards are numbered to facilitate reference and ordering. A pamphlet has been published and is available for those who are interested in cataloguing and card-index work; it gives interesting details of the development of the idea. The stock of cards now covers about 850,000 titles; it is relatively complete in all classes for books that have been copyrighted in the United States since July 1898. Current cards can be ordered on any well-defined topic, the usual price for each being three cents; if ordered by number the price is even less. The number of libraries, institutions, and individuals subscribing to cards has risen from about 200 in 1901 to about 3000 in 1921. About 550 individuals and firms are now ordering the cards regularly, chiefly for bibliographical purposes; the remainder of the subscribers are libraries. The returns to the U. S. government from the sale of cards have increased from about $4000 in the fiscal year 1901-1902 to about $90,000 in the fiscal year 1920-1921. This income now covers the cost of the cards and storage, and the salaries of the 50 assistants that are engaged in the work of distribution. Thus it is that the Card Division of the Library of Congress is self-supporting, and at the same time is carrying on an excellent work that results in the avoidance of the waste that would occur were the 2500 libraries and the 500 individuals that benefit obliged to devise their own indexing system and print their own cards. Many engineers will probably be glad to avail themselves of this service in view of the insignificant expense that is involved.

NEW MODDERFONTEIN, the greatest gold mine in the world, has made another excellent record, thanks in part to the so-called premium on gold. During the last fiscal year, ended on June 30, this mine, at Johannesburg, produced 1,083,000 tons of ore, averaging 9.74 dwt. per ton, the total yield being half a million ounces of gold during the twelve months. The working profit is given at £1,699,052, whereas the dividends amounted to £1,400,000, this being at the rate of 100% on the par value of the shares. The chief feature of the milling practice is the use of Nissen stamps, of which eight more were added during the period under review. The economic character of the lode is indicated by the average assay-value, which is 803 inch-pennyweights. This is the unit used on the Rand; it means, of course, a weighted average, the width of the ore being multiplied by the assay. Between the 12th and 13th levels there is 302,800 tons of 9.7-dwt. ore that is over 82 inches wide, says the consulting engineer to the company. Another interesting foreign item of news is the closing-down of the celebrated Mount Bischoff tin mine in Tasmania, which has been exhausted at last. The lode was discovered fifty years ago and the company exploiting it has paid £210 per £5 share in dividends. In the 'eighties it was the leading tin-producer in the world.

Buried Bullion

Stories of the Spanish dons and their doubloons have become part of our literature from the day that Stevenson's 'Treasure Island' awoke the boyish imagination of elderly men and put jazz into the dreams of faded spinsters. The hunt for treasure has not ceased either in literature or in real life, for every now and again the newspapers tell us of expeditions being outfitted to search for pirate gold in the Caribbean or to unearth buried treasure on Cocos island. The latest yarn comes from Denver, and it is worthy of an altitude just one mile above sea-level. It is a tall story, but it has the merit of being told seriously, which makes it humorous. "I have found", says a Mr. Antony Fenninger, "the key to an ancient map carved in stone; it reveals the hiding-place of $2,500,000 in Spanish gold, buried in the wilds of the

Arkansas Ozarks''. This sounds like old stuff. To give it verisimilitude Mr. Fenninger is organizing a party to dig for ''the tarnished bullion'', so says the 'Rocky Mountain News'. How did he find this map on stone? He tells us that it happened while ''squirrel hunting'', and more particularly while ''pursuing a squirrel''. In his impetuosity he stumbled over ''a stone slab, hidden in the tall grass''. The tallness of the grass is the only touch that redeems this tale from bathos; ancient inscriptions ought to be found on the faces of inaccessible cliffs or inscribed in luminous paint on the walls of mysterious caverns. He scraped the dirt and moss away and called a native to see it, whereupon he heard a true story, which was that the inscription was the key to a paper map for which the Spanish government had made ''extensive search'' many years ago, having heard of the buried bullion, which must have been taken from the Indians, for Mr. Fenninger asserts that the aborigines were so enraged that the Spaniards ''constructed an underground labyrinth of tunnels and concealed the gold in the subterranean passage''. We are not told when this happened, but it must have been after 1492. Why the angry Indians did not interrupt these mining operations is not stated, but we are informed that years passed and that ''close to the opening of the nineteenth century'' the Indians, in a belated fit of annoyance, ''made another and more terrible onslaught upon the Spanish settlers''. This culminated in a massacre, ''only one youth escaping the murderous redskins''. He, it is to be presumed, as it is not stated, carried the story to Spain; for a hundred years later, which brings us to the day before yesterday, a searching party came from the land of Cervantes, armed with an ancient map, but without the stone key. So they failed. Ten years ago a party of native Arkansans heard about the treasure, presumably from a garrulous Spaniard, and ''began searching blindly for the gold''. They found the underground passage and lowered a man at the end of a rope into a cavernous opening to the entrance of which they had penetrated. Soon the man signalled ''frantically to be pulled up''. He died in a delirium. That ended the affair for the Arkansans, for they are ''very superstitious''. They could not be hired to go near the place. Mr. Fenninger is good enough to explain the mystery: ''It is plain to a scientific man what caused the gold-hunter's death. The action of the damp earth upon the mass of gold must necessarily generate a great amount of arsenic gas. It was this gas which killed the man''. Without claiming to be ultra-scientific we venture to doubt the possibility of generating arsenious fume by the action of moisture on gold. Perhaps the decay of timber had produced carbon monoxide gas, which would account for the sickness but not the delirium of the unfortunate gold-seeker. But, we had forgotten that this is only a pipe-dream! We would suggest that the Arkansan descended into a subterranean distillery and that he was overcome by the fume of moonshine; in short, that he was rendered delirious by alcohol. Our story is nearly ended. By aid of the stone map Mr. Fenninger found three more stone maps, the combined information therefrom sufficing to lead him by the squirrel-path to the treasure. He found a shaft, now caved, but he saw evidence enough to satisfy him that it was a real Spanish diggings. He did not penetrate far because he had not yet ''the apparatus to neutralize the effects of the arsenic gas generated by the rare gold below'', but he is making arrangements to unearth the bullion that ''has lain corroding in the black muck of Arkansas for a century and a half''. Mr. Fenninger, for aught we know, may be a sensible man; and it is more than likely that he is the victim of an ignorant Denver reporter plus an irresponsible editor, but if he has found a hole in the ground it is more than likely that it was made in the search for lead ore and it may develop that in his pursuit of a lively squirrel he only caught the tale!

Cost of a Small Flotation Plant

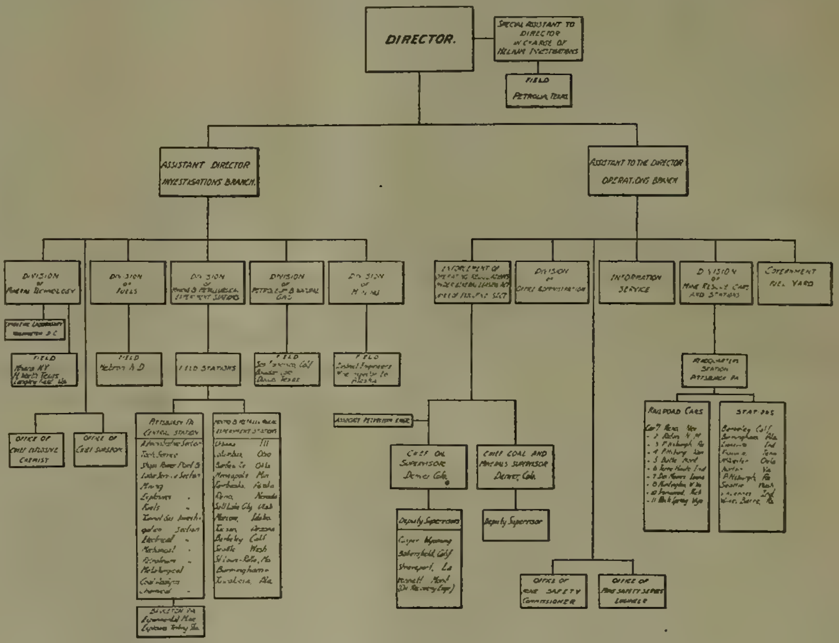
A correspondent from the southern part of Mexico finds himself in the position—by no means unique—of having a mine in which he has proved about 20,000 tons of rock that contains on the average 35 ounces of silver and half an ounce of gold per ton, but that does not as yet qualify as 'ore'. The owner says that the precious metals are contained in, or are associated with, sulphide minerals; that testing by flotation proves 90% of the metal to be recoverable, with an excellent ratio of concentration; and that, if he could find money for the erection of the necessary plant, he could earn a substantial profit. But, he adds, ''the oil-flotation experts talk of nothing but hundreds of thousands of dollars as the cost of building a plant. . . My idea is to start with a unit with a capacity of from 20 to 50 tons per day . He asks for advice. Interpreting what he says literally, the flotation engineers must have estimated the cost of the plant as being at least $200,000. It seems to us that even $100,000 is a high price to pay for so small a plant; and, in this connection, the following data may prove interesting to others besides our friend in Mexico. The factory cost of the equipment in a recently completed 60-ton flotation plant in the United States was $16,851. This included a jaw-crusher, trommel, ball-mill, classifier, flotation-machine, concentrating-table, vacuum-filter, feeders, pumps, elevators, belting, piping, transmission machinery, motors, and the necessary tanks for a concentrator that ought to prove adequate for treating any ore amenable to flotation. The cost of freight, of materials for the building needed to house the equipment, and of the labor and supervision entailed in erecting the plant depends, of course, upon factors that vary with the geography of the mine. In the instance we quote, the cost of delivering the machinery mentioned was $2168; the building material, including cement, timber, corrugated iron, and miscellaneous items, cost $5000; and the cost of construction was approximately $18,000, making the total cost $42,000. The mill was built by an exceptionally competent and experienced engineer whose object was to build a first-class plant without waste, and the result might be hard to duplicate. Another well-built plant, recently finished, has a capacity of 130 tons per day and cost $91,000; and a third, to handle 175 to 200 tons per day, cost $135,000. Manifestly the cost of such plants need not be even approximately proportional to their capacities, but it is apparent that $50,000 should be sufficient to build a complete 50-ton plant anywhere in the western part of the United States. Indeed, it is probable that a serviceable plant could be erected for considerably less. Cheaper machinery might be used, and some of the equipment listed in the $42,000 plant is not indispensable. Although some sacrifice in the cost of subsequent operation and perhaps in metallurgical recovery might be entailed, it is reasonable to say that $30,000 ought to build a workable plant of 50-ton capacity. The distance of the mine in Mexico from the coast or from the nearest railroad would be the most important consideration in estimating the cost of a plant there as compared with a similar one in this country, where, incidentally, the railroads have not, as yet, begun to haul freight for nothing. Other conditions would have their bearing on the problem, and in the absence of further details it would be foolish to make even a conjecture as to what a concentrator at the Mexican mine ought to cost. Nevertheless it seems safe to suggest to our correspondent that, if he is sure of the ore in his mine, it would be to his advantage to consult a competent metallurgist, able to think financially in tens, as well as in hundreds, of thousands.

Philip N. Moore

In this issue we publish an interview with one of the honored veterans of the profession, Mr. Philip N. Moore. That he is in truth a veteran we were hardly aware until he responded frankly to our systematic curiosity, for he is one of the men fortunate enough to retain the spirit of youth long after the time for jumping hurdles or even playing tennis has passed. Youthfulness of spirit joined with maturity of mind is a happy combination, and he seems to have had it from the first. The interview shows how at an early age he went to Leadville, when that famous silver-mining centre was in the heyday of its first development. As one reads of the early days in the West, when the frontier of civilization was on the horizon, one is tempted to ask whether it were not better to have been born sooner so as to participate in the real romance of mining adventure. Later time has brought its compensations, but one thing the younger men may envy, and that is the companionship of such alert minds and interesting characters as were at Leadville, for example, in the late 'seventies and early 'eighties. Nowadays most engineers reside in big cities and make an occasional short visit to a mining district; in former times, owing to the difficulty of travel, they lived in the mining camp, which was fitly named because many lived in tents or shanties, and the community was nomadic. Mr. Moore knows how to express himself; his replies to our questions convey the atmosphere of hope and elation in which he and his comrades lived. He indicates also the vicissitudes of an engineer's life in those days; how the technician had to be ready to do many things and to adapt himself to tasks for which perhaps he had received no direct preparation, but for which he had always, as Mr. Moore had, the background of a thorough technical training and the alert intelligence that came partly by inheritance from quick-witted progenitors and partly from the breezy initiative of what was then the West. The basis of his financial success was the money he made as manager and part owner of two iron-ore enterprises, both of which, thanks largely to his own skillful management, proved highly productive and profitable. This prepared the way for a successful start as a consulting engineer, with headquarters at St. Louis, from which city he traveled far and wide as his engagements called him. The story of the Conrey placer will interest Harvard graduates especially, because it involves several notable men, more particularly the much-beloved Professor Shaler. Another successful operation, in later days, was Mr. Moore's venture in zinc mining, on the Indian lands of the Miami district, in Oklahoma. That was during the War. He sold out handsomely just in time to divert his energies to the national service, to which he has devoted himself since then. His ability to perform a patriotic duty was enhanced by the fact that in 1917 his high standing in the profession was recognized by his election to the presidency of the American Institute of Mining Engineers. That gave him official status as the standard-bearer of the profession. In the rush to aid the Government there was excessive haste to organize committees, which became so numerous that they interfered with each other. Mr. Moore was enabled to prevent duplication and waste of effort by co-ordinating the industrial investigations necessitated by the War. Later he was instrumental in arranging for the representation of engineers, at Washington, especially charged with the duty of pushing the campaign for a National Department of Public Works. This he did in 1918 as a member of Engineering Council, the president of which was Mr. J. Parke Channing, who backed Mr. Moore not only by his voice but by subscribing the money needed to meet the expenses of representation at the national capital. Next came a more arduous task. Mr. Moore was one of the three members of the War Minerals Relief Commission, appointed in 1919 to apportion pecuniary compensation to those who produced sundry war minerals in response to the call of the Government. It is only fair to say that Mr. Moore was the strong man of the Commission and that he did his work under a keen sense of duty and with a sincere desire to do the right thing. He was criticized, of course; and, among others, by ourselves. We took exception to his attempt to prove self-interested motives, as against purely patriotic motives, on the part of claimants, holding that this line of cross-examination was mistaken. That was the only criticism that we made, and our disagreement with Mr. Moore on this point persists to this day, but it has not impaired the goodwill that subsists between us. He keeps his friends, as Stevenson said, "without capitulation". He is not of the small-gauge men that break a friendship on account of fair criticism or reasonable difference of opinion; on the contrary, he conforms to the definition of a friend that we like best: a man whom you know well and still like. Per contra, an acquaintance is a person whom you know slightly and therefore like. From personal knowledge Mr. Moore stands the test we have suggested. He has achieved the two things that men value most: the winning of friends and the realization of a desire to be effective. To this achievement his personal qualities have contributed, for he has a penetrating mind and is a good judge of men; he has social adaptability and an engaging manner; his ability to speak in public is suggested by the style of his diction when interviewed; he has an excellent memory, upon which he can draw confidently for apt quotation, including poetry. Neither the sense of humor nor the wit of the dialectician is wanting. The editor of our New York contemporary described him as "truculently honest", to which he demurred, because the word 'truculent' is assumed erroneously to involve the Hibernian itch for a fight. 'Uncompromising' suits our friend better than 'truculent'. He does not bargain with the truth. He has been a happy man in most things that men value, and most of all in his marriage, for Mrs. Moore is distinguished among American women and a partner in matters of the mind as in domestic affairs; she is now serving her third term as president of the National Council of Women of the United States. Mr. Moore himself is fond of work and does not shy at difficulties; he gives ungrudgingly to the public service; for 12 years he has been on the board of directors of the Missouri State Geological Survey, giving gratuitously not only his time but his enthusiasm for such scientific labors. He took the lead in organizing the St. Louis Section of the Institute, and when president of the Institute he did much to stimulate the vigor and usefulness of similar Sections in other parts of the country. He has the instinct of leadership and the gift of inspiring loyalty. He takes a personal interest in the younger engineers and has helped many of them in making a good start. Of all the rewards that have come to him we envy him most the gratitude of a number of capable and useful men to whom he has given a start, freely and sympathetically, and a helping hand afterward. They and their achievements are a part of his own reputation; they bless him now and they will bless him in the years to come.

U. S. Bureau of Mines

The Act of Congress establishing the Bureau of Mines authorized investigations designed to improve health and safety in the mineral industry, and to promote efficient development and utilization of the mineral resources of the United States. The scope of its work, therefore, is exceedingly wide, a fact that is evident from even a cursory glance through the eleventh annual report of the Director, covering the fiscal year that ended on June 30, 1921. During this period the Bureau has given special attention to the work of aiding the mineral industry to pass through the transitional stage between war activities and normal peace-time operations; to establish it on a safe basis so that foreign competition may be met, and regard paid to the changed conditions of supply and demand. Special investigations have been made during the period under review in connection with the production of various mineral substances; information has been gathered and distributed in regard to the sources of supply. A continuation of the work of determining mine hazards, of promoting rescue and first-aid training, and of studying the use of explosives and equipment in mines has proved of value to the industry. In his letter of transmittal to the Secretary of the Interior, Mr. H. Foster Bain, the Director, shows that the effective service rendered by the engineers of the Bureau at mine-fires and other disasters is attested by many unsolicited commendations. Progress has been made in the development of the experimental plant, at Petrolia, in Texas, to be used to investigate the properties of helium. The mining division, in addition to its regular work of advising and assisting both the coal and metal-mining industries in regard to better and safer practices, has prepared a preliminary draft of regulations for operations on oil-shale and phosphate leases. The owners of pulverized-coal equipment have been advised as to safe methods of operation. Work was continued on the investigation into ventilation, dustiness, and humidity in the metal mines of the West and in the Lake Superior region. Remedial measures for the allaying of dust have been adopted more widely; and efficient systems of ventilation have been installed in mines with high temperatures and abnormal humidities, or in which the air is harmful. The division of mineral technology has completed the preparation and analysis of a number of zirconium-steels for test by the Navy Department, to determine their value as armor-plate; in co-operation with the producers of cerium and of molybdenum a similar series of alloy-steels containing these metals have been prepared. Aluminum alloys have been studied, and valuable data have been obtained as to the causes of loss during melting and casting; methods for the reduction of such losses have been suggested. A bulletin representing eight years of study of electric brass-furnaces has been issued. An investigation of the talc industry was completed, and improved methods of mining and preparation were brought to the attention of producers. A report on the slate industry is being prepared that describes efficient methods of operating quarries, improved equipment for reducing waste, and means of utilizing what is now considered as valueless material. The metallurgic division has continued and broadened its researches on the utilization of low-grade iron ores and the smelting of such material in the blast-furnace. Effective work has been done in improving or devising methods for treating low-grade ores of zinc, silver, lead, copper, and gold. At the Pacific station at Berkeley, in California, an extensive study was completed of the methods of manufacturing caustic magnesia, used for making oxy-chloride cement; it was demonstrated that grades of magnesite not hitherto employed can be used, and standard specifications and tests were devised for the final product. The results of a study of the metallurgy of mercury that extended over several years were compiled for publication. At the North-West station at Minneapolis, in Minnesota, blast-furnace reactions in the smelting of low-grade manganese ore were studied in an experimental furnace, and fundamental data were obtained for further investigations. With the establishment of the Southern station at Birmingham, Alabama, the work on iron ores has been greatly extended to include a general study of the iron industry of that district, with special regard to the utilization of the low-grade and highly-silicious ores that are available. The principal work of the ceramic station at Columbus, in Ohio, has been on clays, graphite, and dolomite. Tests of samples of white clays collected from States east of the Mississippi river have demonstrated that some of them approach English china-clay in quality, and that many of them are suitable for pottery work. Promising results have been obtained in the dead burning of dolomite to be used as a substitute for the more expensive magnesite as a basis for the composition of refractory bricks. The Alaska station at Fairbanks, in Alaska, has aided prospectors and mine operators in their special problems, and marked progress has been made with the general survey of the placer-mining industry. Bureau engineers have also assisted in the development of the use of lignite, in order to conserve as much as possible the rapidly diminishing supply of timber. At the Pittsburgh station, some of the principal results have been in connection with (1) the determination of the properties of picric acid and other explosives; (2) the preparation of a proposed safety code for electrical and mechanical equipment in mines; (3) the determination of combustion factors involved in burning powdered coal; (4) the completion of firing tests to determine the performance of the Scotch marine boiler for the use of the U. S. Shipping Corporation; (5) the determination of the relative steaming values of coke for house-heating boilers; (6) methods for determining accurately the amount of carbon dioxide in the blood of persons exposed to abnormal amounts of the gas; (7) the development of a gas-mask for firemen and for locomotive engineers, respectively, and a universal mask for all industrial purposes; (8) the determination of the constitution of oil-shales, the forms of sulphur in coke; and (9) the action of hydrogen as a desulphurizing agent in the blast-furnace. In co-operation with the New York and New Jersey tunnel commissions, an experimental tunnel has been built to determine the best methods to adopt to ventilate the Hudson River tunnel now under construction. At the Rare and Precious Metals station, at Reno, in Nevada, an improved method was developed for the collection of the emanation from radium salts. The Mississippi Valley station developed two processes for the separation of zinc from fluorspar, thus solving a vexatious problem that has troubled fluorspar operators for some time; the operators of the zinc-mills were also advised how to save the fine zinc that was being lost in the tailing. The Intermountain experiment station at Salt Lake City has continued its work of devising methods for treating low-grade ores from the Rocky Mountain district. It is stated that the results of experimental work on the volatilization process, for the recovery of lead, zinc, and silver, have been applied at a number of mines. Bureau engineers at the North-West station at Seattle have developed methods for the production of iron in the electric furnace; they have also demonstrated that antimony can be removed electrolytically from refractory ores containing that metal. At the South-West station at Tucson, in Arizona, work has been concentrated on the problems connected with the leaching of low-grade porphyry copper ores, and improvements effected, it is stated, are being put into practice by the copper companies. Such is a broad outline of the work that is being accomplished, which should have the unqualified support of the mining industry and of the technical press. The accompanying chart shows the ramification of the Bureau. Much investigative work remains to be accomplished, and we presage that, under the able direction of Mr. Bain, the coming year will see no diminution in the Bureau's efforts to improve the health and safety of those engaged in the mineral industry, and to promote the efficient development and utilization of the mineral resources of the United States.


DIRECTOR.
SPECIAL ASSISTANT TO DIRECTOR IN CHARGE OF HELIUM INVESTIGATIONS
FIELD Petrolia, Texas
ASSISTANT DIRECTOR INVESTIGATIONS BRANCH.
ASSISTANT TO THE DIRECTOR OPERATIONS BRANCH
DIVISION OF FUELS
DIVISION OF PETROLEUM & NATURAL GAS
INFORMATION SERVICE
GOVERNMENT FUEL YARD
FIELD STATIONS
HEADQUARTERS STATION PITTSBURGH PA
RAILROAD CARS
STATIONS
CHIEF COAL AND MINERALS SUPERVISOR Denver, Colo.
Deputy Supervisor
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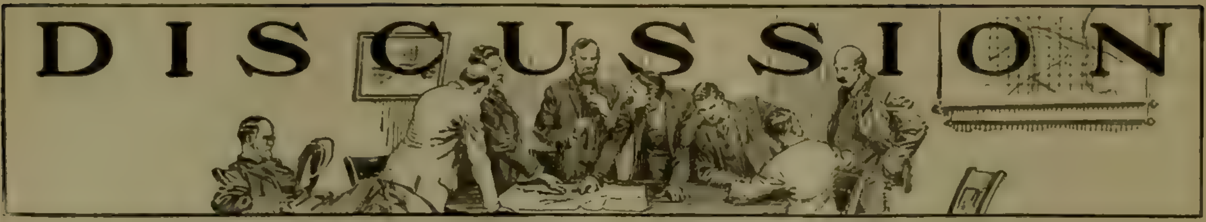
ORGANIZATION CHART OF THE U. S. BUREAU OF MINES



DISCUSSION

Militarism and Millionairism

The Editor:

Sir—Now that the Washington conference seems to be achieving some tangible results toward disarming the world, it may prove interesting to analyze some of the economic features of modern civilization that often are more weighty than the political ones in causing wars. While far from accepting the Socialist theory of history—extensively developed by Karl Marx—which postulates the supremacy of the economic motives as inciters to human activities, I am inclined to believe that any theory that omits them entirely is as futile as would be the play of 'Hamlet' were Hamlet left out.

One need not go far to observe that the age of steam, which began in England in the 19th century, has been characterized by the concentration of great wealth into a few hands. This does not mean that our proletariat has not profited greatly by machine production, for one has only to visit a medieval country like Mexico, where most things are still done by man-power, to disbelieve this popular fallacy. Nevertheless the privileged classes everywhere have captured the lion's share of the benefits of mechanical power, as is evidenced in the United States by the fact that 2% of the population owns 60% of the wealth. This rich minority represents the reservoir of the social surplus, which, by the drawing power of some form of private monopoly, has filled its coffers each year with the residue of the national output after the essential expenses of labor and capital have been paid. Our millionaires are the high priests of Mammon who dominate not only big business but the press, the pulpit, the school, and the Government. Their incomes are so vast that, after providing for their families like rajahs, they have as yearly surplus a huge sum that must seek one of five outlets. The first is luxury, which is always selfish and often decadent or even criminal. The second is charity, which is an outlet of great social possibilities but apt to be misplaced or over-done and at its best no substitute for justice. The third is speculation, which in the form of monopoly of natural resources tends not only to the exploitation of the masses but to the suppression of the middle class. The fourth is the purchase of machinery for increasing production, at home or abroad; and the fifth is the loaning of money to governments. At first thought the last two outlets would seem to be unmixed blessings for society, but in our topsy-turvy organization they have often proved themselves curses instead, by causing the two greatest economic ills of modern times—industrial crises and militarism.

Various authorities give all sorts of explanations for our periodic crises from sun-spots to lack of confidence, but the main cause seems to be millionairism itself, which absorbs a large part of the annual output of commodities that otherwise would be retained by the producers. The difficulty that millionaires have in consuming their incomes causes 'under-consumption', while the opposite phenomenon of 'over-production' does not at all mean that people have enough of material things, but simply that they are unable to purchase them. The present crisis in the United States has peculiarities all its own. Its chief and beneficial result will be a liquidation of labor, which, as I predicted two years ago, was bound to happen before long in spite of the schoolmen. When workmen are getting wages based on a price for their output that represents not fair value but the desperate need of perishing belligerents, anyone not obsessed by prejudice can see that such a condition is bound to be ephemeral. All this, however, diverges from my main theme of militarism.

War in its present economic form may be dated from the later 18th century, when England inaugurated its war-loan policy. This was made necessary by the abolition in 1663 of military land-taxes, which had formerly supplied the national war-funds. While this abolition was hailed as a reform at the time, experience has proved it to be the reverse, for without this new system of public loans none of the destructive wars of recent times could have been fought on the same scale, and many not at all. Under the old system a national war was a burden to the rich landholders, who were obliged to pay its expenses and often had only a slim chance to recoup themselves by the plunder of the defeated enemy.

The public-loan system, however, changed all this, for it now became possible for English landlords to make war a profitable business by the use of a two-edged economic sword that cuts both ways into the national melon. In the Napoleonic wars, for example, the continual destruction on the Continent skyrocketted the prices of English produce so that the landlords could double and triple their rents. These great incomes were then invested in new war-loans, whose service was paid by taxing the consuming masses by the excise and customs. As a net result, in 1815 the British nation found itself with a public debt of £860,000,000, representing an average burden of £200 per family, for the benefit of a few hundred landlords.

At the beginning of the Great War, a century later, the British debt, in spite of numerous economic reforms, had diminished but little, and the war-loan idea had become the fashion everywhere. Moreover, since our Civil War, a new propeller has been added to the war chariot, in the form of mechanico-chemical munitions and apparatus, which cost more money than all the old equipments combined. This alteration in technique, along with the change from the small professional army of William III to the nation-in-arms of the epoch succeeding the French Revolution, has made of war munitions one of the greatest industries of today; and since the formation of the international war trust, a few years before the Great War, undoubtedly the most profitable.

The huge factories required for the manufacture of explosives, guns, tanks, aeroplanes, submarines, and dreadnaughts form the missing link needed to complete the endless chain of our modern economic system; for they create a bottomless pit that can profitably swallow the millionaires' surplus incomes, no matter how big, if only an occasional war be provided to cause a steady market for the munition output. The fact that wars had become an essential for millionaire prosperity tended to abolish the sentiment of patriotism among high financiers. The national press and public officials were suborned as a matter of course, and when this proved inadequate a propaganda was carried abroad to incite the arming of foreign nations, even dangerous rivals to the fatherland. The Krupp company, for instance, of which Kaiser Wilhelm was a heavy stockholder, was accustomed to use the French venal press to advocate the increase of French armaments in order to stimulate a greater counter-arming at home.

Sharing with the European aristocracy the guilt for the vast military and naval expenditures that preceded the catastrophe of 1914, the War Trust enjoyed for many months thereafter such a volume of profit as was never before dreamed of even by pyramiding stock-gamblers. But as the conflict dragged on, beyond all precedent or prediction, the favorite four-spoke cycle, which had served English landlords so well in the Napoleonic wars, of munitions, profits, destruction, and loans, began to get rickety as to its last-mentioned spoke; for even a fool can understand that it is poor business to sell munitions to a government, even at huge nominal profits, if he is being paid for them with his own money that has been exchanged for worthless bonds.

The entrance of the United States into the War in 1917 saved the day for the American branch of the War Trust, because with the ten billions loaned by Uncle Sam to his Allies the latter were soon able to liquidate their big munition debts to his manufacturers in cash. Meanwhile things in Europe kept getting worse for the War Trust. The defeat of Italy and the collapse of Russia in December of the same year not only spelled ruin for stock-gamblers everywhere, but was bad news for the War Trust, for it meant the repudiation of billions of Czarist bonds exchanged abroad for munitions.

The final defeat of the Central Powers gave promise that England might be able to retain her solvency; she still had great investments in countries unharmed by the War, her factories were intact, and she had been wise enough to tax her rich heavily, by comparison with others, but quite insufficiently to prevent the accumulation of a monumental debt. On the contrary, France and Italy had taxed everybody except the rich; while Germany and Austria were equally partial. To pay war expenses all these plutocracies relied on fiat paper-money, which is merely national promissory notes. Though nominally of forced circulation, it is clear that an issue of fiat money can only be made legally obligatory for the payment of debts previously contracted, and that none need sell their merchandise for it at any fixed price. Wherever the European belligerents attempted to fix prices for commodities below their commercial value in paper money, such commodities promptly vanished from the markets and became contraband. By this suicidal policy the European plutocracy reduced to poverty that large part of the middle class which had its property in forms of money, such as mortgages, bank-deposits, or cash, and inflicted untold suffering upon that large part of the working class which was unable to get its wages increased in accord with prices. The only profiteers were the big monopolists of tangible chattels and natural resources, and middle-class people whose fortunes were in real estate, for their property values were unaffected by fiatism, which also reduced their taxes to zero.

As the value of any promissory note depends upon the solvency of the maker, it is evident that the fiat money of any government whose outgo exceeds its income will soon become worthless. The failure of governments to balance expenditures with taxation was bad enough in war-time, but since then the same policy has been inexcusable. For a while after the Armistice, France, Italy, and the rest were able to stave off disaster by drawing on their credit with Uncle Sam; but when these were finally cut off, in response to the warning of Mr. Hoover, the avalanche of ruin again gathered headway in spite of the brake put on it by the suspension of interest on the ten-billion debt to America. Then began the Allied propaganda for the cancellation of this debt altogether, an agitation that is still on foot at the Washington conference.

On account of this financial pap from America, supplemented by German reparation payments in goods and gold, the franc has only fallen 60% and the lira 76% from the par value, as compared with a drop of nearly 99% for the mark. The post-war crisis for the economic system of Western Europe has thus first appeared in Germany, and she is now face to face with the question: Will you repudiate your debts and slide into the Bolshevik night, like Russia, or will you master your plutocracy and socialize economic rent and great inheritances? Chancellor Wirth appears alive to the situation, though his proposal for a 20% levy on all property is clumsy, unjust, and inadequate to solve the problem permanently. The German monopolists, in opposing his plan, prove again the old proverb: "Whom the gods will destroy they first make mad", and the beginning of the economic revolution appears imminent.

Should Uncle Sam, persuaded by sophistical arguments, be so foolish as to forgive his European debtors, he will not only do a rank injustice to his tax-payers but will strike a blow at the progress of civilization; for such a mistake might postpone the inevitable change of our unethical economic system for a generation, by enabling the Allies to stave off the crisis now facing Germany, and result in other great wars. Modern civilization can never establish a permanent peace until it has abolished its two war-making classes, which are military aristocracies and hereditary plutocracies. The Great War appears to have done for the former except in Japan, but the latter seems to have emerged from the conflict even stronger than before. Until public expenses are paid entirely from the social (as distinguished from individually earned) wealth, so that no millionaire fortunes can be made, and the existing ones are destroyed by death dues, we shall always be living under war-clouds, however vociferous may be such makeshifts as Leagues of Nations and Disarmament Conferences.

ROBERT BRUCE BRINSMADE.

Ixmiquilpan, Mexico, December 20.

Ball-Mills

The Editor:

Sir—Mr. Benitez, in his article on 'Ball-Milling and Flotation at Catému, Chile', which appears in your issue of December 24, suggests an improved liner-bolt for ball-mill shell-liners. This is shown on page 884, Fig. 4, and has a square head, tapered. The bolt suggested was in use long before the bolt shown in Fig. 3, which he is now using, and was not satisfactory. It is more difficult to get a good fit between the liner-hole and the head of the bolt than by using the present form. The requirements are that the bolt be placed in the position subject to the least wear or which is the thickest when the liners are nearing the end of their life. The counter-sink should extend through to as near the bottom of the liner as practicable, so as to hold the liner when it is thin. If the liner is of manganese-steel, there will be some stretching of the metal, and this will give trouble if the counter-sink extends clear through. The stretching action gives trouble in any type of bolt-head. It is my opinion that a flat-angle taper with a head as shown in Fig. 3 will hold far better than a slightly tapered square head as shown in Fig. 4.

Referring to Mr. Benitez's statement, "The matter is well worthy of investigation by mill manufacturers", I wish to correct his impression. The manufacturers of ball-mills are all striving for increased length of liners; the method of fastening liners, the position of the bolt, and the shape of the liner have been discussed with mill-superintendents and operators, and their suggestions have been given close attention. Since my first mill experience in 1908 there has been a gradual increase in the life of the liners in tube-mills, ball-mills, and grinding-machines of this kind. I can remember distinctly, and have among my notes, the life and wear of liners in ball-mills used in the Western States in 1917; there has been a remarkable increase since then in tonnage ground, based upon reports I have seen lately.

Mr. Benitez has presented a very informing article and one that should cause some valuable discussion. I hope that some of those directly interested will reply.

P. R. HINES.

Portland, Oregon, December 30.

Lime in Cyanidation

The Editor:

Sir—In conducting cyanide tests on Rochester (Nevada) silver ores an unusual and interesting fact was discovered in connection with the use of lime. Most of the oxidized ores from the Rochester Silver Corporation's mine yield 80 to 85% of their silver content by simple all-sliming treatment. The consumption of lime is 10 lb. per ton of ore. In a stope on the main vein a block of ore was found to give an extraction of only 35%. An analysis of this ore gave:

	%
Silica (insol. residue)	86.00
Iron oxide	7.71
Alumina	0.29
Antimony	0.83
Copper	0.05
Lime	0.15
Sulphur	0.82
Phosphoric acid (P_2O_5)	0.80
Loss by ignition (water of combination)	3.05
Magnesia	Trace
	99.70

From this analysis, antimony would be the only mineral that one would suspect to be the cause of the poor extraction. Other parts of the vein showing 1 to 2% antimony gave an 85% recovery in the mill. It was assumed that in this case a large percentage of the silver was combined with the antimony.

Experiments were made to determine the effect of lead acetate, preliminary sulphuric acid treatment, tartaric acid, sodium and calcium hyposulphide, caustic potash and soda, lime, and several others, none of which gave any encouragement except sulphuric acid and lime.

In determining the lime factor, varying quantities were used, from 1 to 30 lb. per ton of ore. The available CaO in the lime used ran from 85 to 90%. The results of this experiment follow:

		Extraction, %
1	lb. lime per ton of ore	24.5
2½	" " " " " "	26.5
10	" " " " " "	33.0
20	" " " " " "	39.0
30	" " " " " "	40.5

The experiments were continued, and resulted in the following, which are averages from 112 experiments:

		Extraction, %
60	lb. lime per ton of ore	61
80	" " " " " "	80
100	" " " " " "	89
130	" " " " " "	92

Giving the ore a preliminary lime treatment, washing and then cyaniding gave very poor results. This proved that it was necessary to have the lime present during the cyanide treatment; 35 to 40 lb. of lime per ton of ore was found in the tailing from the experiments which were made with the maximum amount of lime. Any effort to decrease this loss resulted in lower extraction. As lime is more soluble in cold than in hot water an attempt was made to reduce the amount of lime by agitating in colder solutions. A mill temperature of 60°F. gave a 70% extraction, whereas 120° gave 90 to 94% extraction. The heat was increased to 140°F., but only decreased the time factor. The consumption of cyanide increased as the extraction increased. At 35% the consumption was 1 lb. per ton of ore; at 90% it was 3 lb. per ton of ore. A 1 to 1 dilution was found to be as good as a 4 to 1. The amount of lime required decreased as the silver content of the ore decreased. The gold extraction remained the same, 90%, and whether 10 lb. or 130 lb. of lime per ton of ore was used. The mill has treated 1800 tons of this ore, and mill extraction has checked the experimental work.

Difficulties were encountered in clarifying solutions and in precipitation following a 6-day run on this ore. A white precipitate was deposited on the clarifier leaves, on the surface of the thickeners, in pipe-lines, and on the zinc thread in the zinc-boxes that were in use at that time. It was very harmful in the zinc-boxes, coating the zinc so badly that precipitation ceased. Cleaning the boxes was the only method used to remove it. An analysis of this white precipitate gave:

Silica and insoluble matter........................	10.60%
Iron and aluminum oxide (Al_2O_3, Fe_2O_3)...........	10.76
Zinc	trace less than 0.2%
Cadmium	trace " " 0.1
Lime (CaO)	34.72
Magnesia (MgO)	trace " " 0.2
Loss on ignition (combined water and CO_2)........	33.16

These difficulties were eliminated by treating the ore in small lots at intervals of several days.

The ore assayed 30 to 34 oz. silver and 0.10 oz. gold. With the increased cost of lime and heat the treatment was a commercial success.

W. G. EMMINGER.

Rochester, Nevada, December 5.

Premium on Gold in England

The Editor:

Sir—In discussing the McFadden Bill in your issue of November 26, Mr. Kidder said, "England has recognized the situation by the payment of a premium to South African producers". This is not so; what England did was to remove the embargo placed on the movement of gold during the War, thereby giving African, Australasian, Indian, and other dominion producers an unrestricted or open market. The mint price of pure gold is approximately 85 shillings per ounce, but by selling in the open market the producers realized a higher price, which might be construed to be a premium, but in reality it is simply a higher value owing to the low exchange on the paper pound sterling. The highest price that gold reached in England in 1920 was 127 shillings and 4 pence, equal to 50.1% above the mint price. That was in February, when sterling was at the rate of £1 = $3.30. The average for 1920 was 112 shillings and 11 pence. In February 1921, when sterling was £1 = $3.82, gold dropped to 106 shillings per ounce. Since then it has been see-sawing, until today, when sterling is £1 = $4.90 and gold in England is worth 102 shillings and 11 pence. Every increase in the exchange value of sterling is watched with more or less apprehension by the owners of low-grade gold mines in Africa and Australasia, as their so-called premium or extra profit becomes so much less. If sterling should get back to normal (£1 = $4.86) there would be no premium on gold. The price works automatically, and the Government has nothing to do with it; that is, in the way of paying a premium.

Pittsburgh, December 2. M. W. VON BERNEWITZ.

Cajon

The Editor:

Sir—In the article on ancient South American milling and amalgamating practice, published in your issue of October 1, the term *cajon* is explained as a box, probably used as a measure. Although this term is certainly derived from the Spanish word for box, in mining terminology a *cajon* is a definite weight, being equal to 50 *quintales,* of 5000 Spanish pounds (2300 kg.). This shows that a *cuerpo* contained about 2500 lb. of ore and that the consumption of salt was 8%.

Nowadays very few people use the term *cajon* in South America, but one frequently hears the expression "*marcos por cajon*" to indicate the grade of silver ore, especially in Bolivia and Peru. One marco is equal to half a Spanish pound, or 7.39 oz. troy, so that a silver content of one *marco por cajon* equals one ten-thousandth part, or 0.01%. In Chile the grade of silver ore is often expressed in ten-thousandths parts (*diez milésimos* abbreviated to D. M.), which is exactly the same figure as *marcos por cajon.* One *marco por cajon,* or one D.M., is equal to 2.92 oz. troy per ton of 2000 pounds.

Santiago, November 8. M. G. F. SÖHNLEIN.

Definition of Engineer

The Editor:

Sir—Replying to Mr. Parsons' letter on the definition of engineer, I would refer anyone interested to a long article on the subject in 'Engineering and Contracting' of July 28, 1920. Alfred P. Flinn and associates, who prepared the article, discouraged any attempt to define the engineer. Most definitions, of difficult terms at least, can be picked to pieces and discredited by skilful dialecticians. Mr. Parsons' definition of engineer is one of the worst I have seen. He says that engineers create things. On the contrary, many of them merely condemn prospects, transport things, tear things down (such as New York skyscrapers that are considered obsolete), or measure things. Moreover, he states that engineers toil for humanity's betterment. I fear that most of my engineering friends, then, are not engineers. They toil for money, although they are not always as successful as they deserve. Again, do military engineers that design devices and concoct poisons for killing people better humanity? I am reminded of Dr. Johnson's definition of network as "anything reticulated or decussated at equal distances, with interstices between the intersections".

P. B. McDONALD.

New York University, December 22.

Philip N. Moore, of St. Louis

An Interview, by T. A. Rickard

You are not a native of Missouri?

I was born in Indiana in 1849. My boyhood was spent partly in Ohio and partly in Missouri.

What was your father's occupation?

My father was one of the early civil engineers of the Mississippi Valley—a canal and railroad builder before my birth. The happening of my birth in Indiana was that he was there as engineer of a canal. He himself came—

He himself came from New England?

He was a Pennsylvanian. My mother was a New Englander, from Connecticut. Through her I am eight generations American. My ancestor, John North, came to this country in 1635. On my father's side the family was Irish, my great grandfather, Henry Moore, coming to this country in 1773.

What was your early education?

I was graduated in the classical course by Miami University, one of the oldest colleges of the Ohio Valley; my technical training followed at the School of Mines, Columbia University, where I studied under Newberry, Chandler, and Egleston, master-teachers of their day, and, I am proud to say, my friends in later years.

When did you graduate?

I was a special student at Columbia from 1870 to 1872.

Among the mining engineers who were your classmates at Columbia?

Pierre de Peyster Ricketts, Arthur F. Wendt, Frank P. Jenney, and Peter T. Austen.

What made you take to mining engineering?

My father and two older brothers followed civil engineering and railroad building. Perhaps the desire for more individuality, the uncertain tenure of railroad positions at that time, or the romance of mining, then even more attractive than now, may have led to my choice.

How did you get your first job?

While a student at the School of Mines, Major T. B. Brooks, then in charge of the Michigan Geological Survey, in the iron regions, who was wintering in New York, was good enough to offer me a position.

Then you went to Michigan?

A season on the Michigan Survey under Major Brooks gave me a start in geological work which enabled me to secure a job under Raphael Pumpelly, then State Geologist of Missouri, which service was for only about a year by reason that one of the then, as even now, common incidents of State geological work—failure of appropriations—caused me to seek another job, which I found promptly under Professor N. S. Shaler, of Harvard, just appointed State Geologist of Kentucky. Under him, I worked nearly four years, when fortunately for me, from a financial standpoint, appropriations were again cut, and I sought wider fields, going to Leadville, Colorado, where I was one of the pioneers. In the interval I spent about six months in Europe.

In what year was that?

The spring of 1878.

Leadville must have been a lively place then?

It was an example of the ways of the frontiersman at that time—wild to him who sought such surroundings, but filled with the most attractive and intelligent set of young technical men with whom it has ever been my good fortune to foregather. This was in the early days of the technical engineer, who came into his own in a remarkable way. Never in all the years since, have I dwelt with men of higher average intelligence and comradeship than the circle who made their start at Leadville.

Please mention some names.

A. R. Meyer, A. A. Blow, William Byrd Page, Fred Bruen, W. F. Patrick, Thomas L. Darby, Charles J. Moore, Max Boehmer, D. W. Brunton, Arthur D. Foote, Ferdinand Van Zandt, James B. Grant, W. S. Ward, Ralph Nichols, Henry E. Wood, and many others.

Did you meet Dr. Raymond at that time?

Dr. Raymond was not infrequently at Leadville, as expert witness in the important apex lawsuits, which dominated the courts of Colorado for years.

What was your first job there?

My first position was as smelter superintendent for a firm, for whom I built the second smelting plant at Leadville, subsequently known as the La Plata works.

Where did you get your previous experience for this job?

The task came to me unsolicited. It may be that it was a case where need, with possibly favorable impression of training or character, forbade rigorous insistence on experience. Smelting was very profitable. Charges ranged from $25 to $40 per ton. My employers fully understood the profit of hard driving. The already going plant was doing clean and slow work, smelting perhaps 15 tons of ore per day in a small stack. Using furnaces with about 40% larger area, we put through 40 tons per day—of course, not making as clean slags, but largely increasing profits. The waste was of small importance in view of greater tonnage.

Did you continue in charge of this smelter?

Less than two years, when I went 'on my own', leasing, prospecting, of course, and finding in the mining activity at that time sufficient examination work to keep me going in comfort.

Please tell me, Mr. Moore, what sort of fees did they pay at that time?

We used to get $25 per day, with an occasional $50 if the case were important. These were rare.

What were the conditions of living?

Somewhat crude, but not necessarily involving hardship. In the early weeks when we were establishing ourselves in California gulch, five of us, partners in a claim, shantied near where the Grant smelter was subsequently erected, doing our own cooking week about, until it developed that one of our party, a chemist, was an admirable cook—John H. Talbutt. Then it was agreed that he should do all the cooking, the remainder of us taking turns washing the dishes!

So you had a good time?

The place was full of hope and excitement. The atmosphere was optimistic, fear of failure was small; youth, courage, and hope took from poverty its sting. It mattered little were a young man 'broke', for he fully expected to strike it again the next day.

How long did you remain at Leadville?

Until early in 1882, when unexpectedly an offer came to me to open an iron property in Kentucky, which I had known and described years before when I was on the Geological Survey, with no expectation that ever the opportunity would come to me to share in its development. This offer was such that although I had fully expected to end my days in Colorado, it could not be lightly refused.

How much money did you take with you from Leadville?

A few thousand dollars, enough to make me feel independent as against the near-by contingencies of life.

So you took charge of this iron property? Did the operations involve anything interesting in a technical way?

Nothing complicated. It was the simplest of quarrying operations, which was naturally one reason why it offered a chance for profit. It was known as the Slate Creek Iron Property. Upon it was built in 1791 the first blast-furnace west of the Alleghanies. I remained in personal charge of it for seven years, then my children—

When were you married?

In 1879, to Miss Mary Eva Perry, of Rockford, Illinois, who went with me as a bride to Leadville, under the great pity of her friends, who thought that she was taking grave risks in going to such a lawless land, which anxiety might have been more intense had they known the experience of her first week, when she saw two policemen shot under her window. In 1889, my children reaching the school age, I removed to St. Louis—my old home, where I have dwelt since.

Why do you call it your old home?

My father moved here in 1859.

You established yourself in St. Louis in a consulting capacity?

In a consulting capacity, retaining charge of the iron enterprise of which I was the chief executive and a part owner. The proposition which carried me from Colorado covered not only what for that time was liberal compensation, but a year's option to take one-fourth interest in the enterprise, which I was able to do.

What was your next departure?

I retained charge of this enterprise until it was worked out, meantime with friends acquiring a large brown-iron-ore property in Alabama, which we retained for a number of years, but finally sold to one of the larger Birmingham consolidations. I was president of this company for 18 years.

You have had a good deal of experience in the mining of iron ores, which is unusual among our Western men.

Our operation in Alabama originally started with a charcoal blast-furnace. This was abandoned with the exhaustion of timber, ending in commercial mining of ore for various furnaces in Alabama and Tennessee. We operated a very large brown-ore mine known as the Baker Hill. It carried an ore lens about 100 ft. thick and 300 ft. long. When the overburden was light, we mined this cheaply. Evidence of this is that in the hard times of the '90s we sold iron ore as low as 80 cents per ton of 2240 lb., and more than covered expenses, our actual mining cost including overhead at that time being about 60 cents per ton. Of course, this did not pay for depletion, but it kept the operation alive in hard times. The same ore during the War would bring approximately $3.50 per ton.

That brings us to what year?

This property was sold in 1908. During all this time I was practising as work offered, ranging, with the usual fate of the consulting engineer, over most of the mining States and Territories, into Canada and Mexico, traveling for some years around fifty thousand miles per annum.

Can you mention any of your operations that proved important or otherwise interesting?

Probably on the whole the most interesting enterprise with which I have been connected, and which in fact I organized and assembled, was the Conrey Placer Mining Company, of Montana.

How did you get into that?

In 1896, while employed by Bigelow & Bixby, of Boston, to examine a placer in Idaho, on the request of the promoter, who was with me, I stopped off at Alder Gulch, Montana, to see a proposition on which he then had an option. This property was known as the German Bar tract. It covered about 1½ miles of the gulch. The operation contemplated was the re-working of the old tailing by machinery. It developed that this tract was under option to another party, whom I met on the ground. The incident was pleasant to neither party, but I recognized possibilities, which led to the request that should the then holder of the option fail to close, it should be offered to my clients. At the same time, I was shown the Conrey ranch at the mouth of Alder gulch, by John C. Sloss, an old Montana miner, who stated that he had talked with the owner and could secure an option for a year at a reasonable price—$30,000. While in Idaho, the option on the German Bar property lapsed and was promptly taken up by my clients. We re-visited the property in October and closed for its purchase, paying one-quarter down, the rest in three equal payments. If I remember correctly, the price was $100,000. At the same time prospecting work was started upon the Conrey ranch, on which we developed more than 200 acres of payable dredging ground. It was acquired by my clients in the following year.

HARRISON AVENUE, LEADVILLE, IN 1879

Was Professor Shaler one of your clients?

Professor Shaler was associated with the gentlemen whom I have mentioned. He enthusiastically accepted, as he had done through nearly 30 years of our close business association, my judgment regarding this property. He visited it the following summer, after it had been purchased.

That was in 1897?

Yes.

When did Hennen Jennings become connected with the enterprise?

Nine years later—in 1906, when he and his associates purchased my interest.

Did you have any interesting technical experience in connection with this enterprise?

The first attempt to work the property was by means of an excavating cable-way; this was an ingenious device, developed for us by the Lidgerwood company; it functioned profitably on relatively high-grade gravel in the upper part of the German Bar tract. The first year's work, if I remember the figures correctly, upon this tract yielded 37c. per cubic yard at a cost of about 24c. This was free ground which had been worked over by the old-timers by the 'shovel in and shovel out' method, under which each miner was allowed but 100 ft. of the gulch for his claim and had to deliver the water to his neighbor below, free of sand. Operating cost of the cable-way was prohibitive for the ground on the Conrey ranch. We therefore came to dredging, which, at that time, was being carried on in Grasshopper gulch, some 40 miles distant, with small double-lift dredges.

Was Ben. S. Revett there then?

Previous to that time he had been, but not actively at the time of which we are speaking. In the dredging industry we experienced the usual history of early developers; we built machinery and tore it to pieces, rebuilding stronger, and repeating the operation until at last machinery was evolved to meet our requirements.

Can you give me comparative figures for the capacity of the dredge and cost of operation at the beginning and at the end of the period of growth?

At the beginning of operations single dredges used 3½ to 5-ft. buckets, steam-driven, involving costs of from 12 to 13c. per yard. The property is now almost exhausted, but one dredge remains, electrically driven, with 16-ft. buckets, handling nearly 400,000 yd. per month. It has shown a cost, for an entire year, after full charge for upkeep, of 3.16c. per cubic yard.

Did you make any innovations in dredging practice?

We were the first to prove that dredging was practicable throughout the Montana winter, incidental to which we introduced the plan of flooding the surface to keep the loam from freezing, in which also I think we were pioneers.

What was the capacity of the 5-ft. dredge?

About 40,000 cu. yd. per month.

One-tenth of the present rate?

Yes. The Conrey property in its earlier days, until the time came for excavating the fringes of the main deposit, was remarkable in its uniform yield. It was at times almost possible to predict a clean-up from the number of hours operation of the dredge.

This enterprise, taken altogether, proved highly profitable?

It has been very successful.

Roughly, how much, a million or two million dollars?

I have not the figures to date. Judging from the output for the time when it was under my close knowledge, I estimate that the property has yielded gross around seven million dollars.

Did Harvard College participate in these profits?

Colonel Gordon McKay, a retired mechanical engineer, of the older generation, a client of mine for 30 years or more, came into the Conrey property after my original employers reached their financial limit. He had been many years retired and was but casually interested in life. The control of the property that, during all the mechanical difficulties of operation, always responded to work by production, revived his interest in his old profession. He died before the property had got to its big results, but with absolute confidence in its outcome.

What was McKay's relation to Harvard?

Colonel McKay left his estate to trustees, to be used for the benefit of Harvard College. This included his interest in the Conrey Placer Mining Company.

You were engaged as engineer in other placer-mining operations in the West?

Only on examination work.

You were much in Mexico?

For several years, until the revolution unseated Diaz, a large share of my work lay in Mexico.

Did you have anything to do with lead mining in Missouri?

I have had no executive responsibility for any of the large operations. Some years ago, C. P. Perin, of New York, and I examined one of the large properties as a preliminary to some financing. We recommended the loan. For a time thereafter I represented the bondholders on the board of directors, and as such had knowledge in detail of what was being done. This was the Doe Run Lead Company of south-east Missouri.

I remember, Mr. Moore, when I was at Joplin, in 1917, I heard of your successful zinc operation in the Miami district. Will you state how you got into that?

This property consisted of 120 acres of Indian leases, which were brought to the attention of some of my friends and myself, with the result that it was undertaken and developed to a producing property, but was sold within less than two years to wealthy oil-operators of Tulsa, Oklahoma.

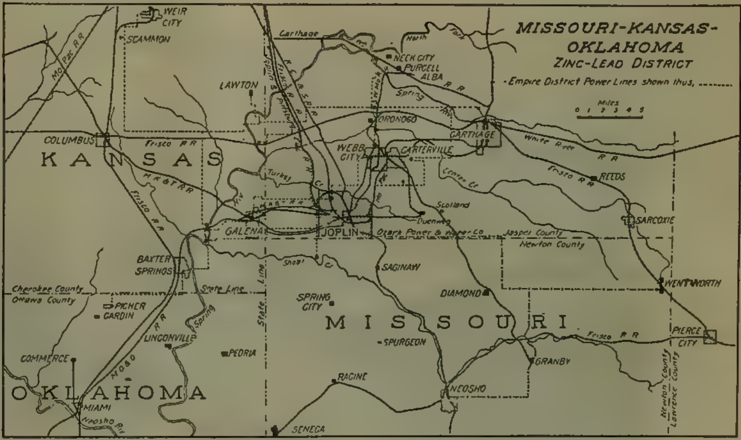
This was the Admiralty mine, was it not?

This was the mine of the Admiralty Zinc Company. It is still operating, one of the steady and largest producers in the district.

You obtained the ground on leases from the Indian owners?

On the contrary, the leases were taken from sub-lessees.

On what royalty?



Royalties varied from 15% to 20%.

Were the Indians greatly enriched by the transaction?

At the time we sold we were paying about $5000 per month to one Indian.

Did you have anything more to do with that interesting district?

Not since then.

What were you able to do during the War?

If I was of any national value during the War, it was because of my work to prevent duplication of effort on the part of various committees and organizations; and in the formation of what was then known as the War Minerals Committee.

At that time you were President of the Institute, were you not?

I was elected President of the American Institute of Mining Engineers less than sixty days before the declaration of war. Immediately following, enthusiastic and patriotic engineers urged that I place the Institute at the command of the Government. Various technical committees had been organized. My service consisted in helping to co-ordinate these committees, and preventing special investigations of mineral resources by a certain very potent Board, by showing to them that the Government bureaus were already in possession of a vast body of information which could not be duplicated in reasonable time by new investigators. I insisted that the committees, wherever possible, should work through the existing government agencies: the Geological Survey and the Bureau of Mines.

You have not mentioned the most direct service and the one that entailed the greatest amount of your time and patience, namely, the War Minerals Relief Commission; when did you begin that work?

I first learned the intention of Secretary Lane to organize such a commission by the receipt, in March 1919, of a telegram from him, asking if I would accept appointment upon it.

Your colleagues, as I remember, were Senator Shafroth and —?

My colleagues were Ex-Senator Shafroth, of Colorado, Ex-Representative Foster, of Illinois. In a few months, Dr. Foster's death left a vacancy which was filled by the appointment of a mining engineer, Mr. Horace Pomeroy, of San Francisco.

How long was that commission in existence?

Although Secretary Lane stated his expectation at the time of appointment that the task would be accomplished within a year, it actually required more than two.

As you know, there has been criticism of the rulings of the Commission, and some of it may seem to you to have been unfair. You must now be in a position to look back upon your work with a good deal of satisfaction?

Possibly enough time has not yet elapsed to enable me to take a detached view of the work, and its critics, but under my present light, I cannot see any line of decision, or method of treatment in the cases, which should be materially modified.

Won't you say something about the difficulties that you encountered?

The criticism came from interested and disappointed parties. Further, the rulings which resulted in the elimination of the largest number of claims were forced by legal opinions of the Solicitor of the Interior Department and the Attorney General of the United States, which were mandates to the Commission, and necessarily to be followed. The task was one of great difficulty by reason that there were no contracts formal or informal. The duty of the Commission was to determine what "net losses" had been incurred by claimants "in consequence of" request or demand of certain named governmental agencies. Necessarily, if a man, previous to the entry of the United States in the War, had been engaged in the industry which resulted in loss, the Government could not have been responsible, unless he could show either that he had increased loss by additional investment through Government request, or that he would have ceased but for it.

Then it became a question of determining the amount of stimulation for which the Government was responsible?

Underwriters Admiralty Skelton

IN THE TRI-STATE ZINC REGION

Yes. It was readily seen that a matter of this kind was one of great difficulty; especially in view of the naturally insistent demands of claimants, who, once possessed by the belief that the Government is their debtor, are apt to lose the sense of proportion.

You have reason to be proud of having been President of the Institute. You probably have definite ideas as to the functions that the Institute can best perform in behalf of the profession?

Naturally, I have given thought to such matters, some of the conclusions of which were expressed in my report at the time I passed from office. The problems are difficult. They lie between extreme centralization of control, with fair efficiency, and the opposite of decentralization, with loss of continuity of action. The gravest problem is to secure a voice in the detailed policies of the Institute for the men in the hills who do the real work of the profession. My theory of it is that ultimately the directors must be chosen by districts and some method evolved by which their attendance, at a reasonable proportion of the meetings of the board, at least, can be secured. The next in importance is to get the membership to realize that they have obligations to the organization. To my knowledge it is the earnest desire of the men in the East, who now necessarily make the decisions of the Institute, that the West shall have and exercise a potent voice. To that end, Western directors are always elected, but instances have arisen where a man would remain a member of the board for three years without attending a single meeting. At the present time there are five directors from the West, only one of whom has attended a meeting since February. In 1919, of three Western directors, two attended one meeting each. In 1920, of four Western directors, one man attended one meeting, and in the first half of 1921, with five directors, no man has attended any meeting.

Mr. Moore, what do you mean by the West? To us who live in San Francisco, the West probably begins nearer the Pacific than it does with you; do you mean west of the Mississippi River?

West of the 100th meridian.

Which is —?

In or west of the Rocky Mountains.

But, surely, the gentlemen in New York consider St. Louis west, do they not?

That is true of many, and in our own minds, we hold with them. I am thinking as I speak of the Mountain and Pacific Coast membership.

The problems of the national engineering societies are difficult for the reason that none of them are able to carry their necessary expenses from the dues and initiation fees paid by the members. There has grown up, however, a constant small revenue from the sales of publications, which have made up the deficits.

To what extent is the financial stringency of the Institute due to the exuberance of its publication activities?

I am not prepared to accept the word "exuberance".

Go ahead.

There is always to be heard the voice of the man who wants few publications. Generally, he is mature and has acquired a permanent set as well as a specialty. A young man, still believing that his future may lie in any one of many directions, is apt to want everything he can get. These young fellows accumulate documents, reports, and papers after the fashion of the young wife in the Kentucky mountains. Years ago, when examining a coal tract in Breathitt county, I was directed to the home of a man called Old Flint Ridge George Miller, who would not only take care of, but would vouch for, me—sometimes important in that country. In the home—a two-room cabin—were the old man and his wife, my assistant and myself, and upstairs, the youngest son with his newly won bride. They were building a cabin over the hill. The old man, commenting on the new daughter-in-law, said: "That thar gal is just like one of these yar mountain rats—every time she goes into that house she carries something". These young engineers often carry information to their files more effectively than to their intelligence, until years teach them the improbability of ultimate omniscience, and they reject, initially, material which they know is likely to be of small use.

You anticipate the revival of mining, do you not?

I have no idea as to time, but the curve of mining, like other business, shows recessions and subsequent peaks. One of the advantages of years is a realization that metal production will not cease. I remember in the 'eighties traveling with an old friend who had been long in copper mining. The metal at that time was worth about 9 cents per pound. His depression was great, and he expressed the desire to get out of the industry, fully believing that it would never be any better. He did withdraw from his then active operations, but since then he has been almost constantly interested in other copper enterprises.

If we remember that, roundly speaking, the metal production of the United States doubles every ten years, producing thereby practically as much as in the whole previous period, you will find it difficult to doubt the return of large production. I believe in the increasing value of deposits of all mineral ores. The public does not realize that in mining we draw on a bank account where no deposits are made and that the easily accessible deposits are becoming steadily less. Therefore, the value of good mineral deposits is bound ultimately to come to the higher level. To develop them will create continually increasing demand for engineering skill, but it is more than probable that the engineers who so serve will be spokes in the wheels of great organizations rather than independent producers.

Have you any pronounced ideas on mining education?

I have a growing realization that after all, the greatest ability lies in the power to persuade and direct one's fellow-men. Mere technical knowledge can never give this. Possibly it is entirely a matter of native power, which no education can impart. I believe, however, in a broad grounding in the fundamentals of science, history, and language, rather than in the attempt to teach finished details. The young man leaving the mining school is largely a creature of chance, tossed by the waves of opportunity into the channel of activity where he finds sustenance. If he be well grounded in the great fundamentals of science, with the ability to write and speak the language, he can acquire the details of the calling into which he has come, far better than he can acquire the fundamentals which may be missing, should he have prepared for another line of industry than that in which he is cast.

VANADIUM, according to a bulletin of the Arizona State Bureau of Mines, was first employed by Berzelius in the manufacture of a black ink, which it was later found could be made indelible. For many years this was the only industrial application. In 1861 Saint-Claire-Deville proposed its use in the ceramic arts, and about the year 1870 vanadium commenced to play an important part in the industry.

IN THE MOUNTAINS OF BRITISH COLUMBIA

The Nugget Gold Mines, at Salmo, British Columbia

By George H. Shepherd

The properties of the Nugget Gold Mines, Ltd., are situated on the north side of Sheep Creek canyon in the Nelson mining district, British Columbia. They occupy the entire slope, from the creek-level to the old Nugget workings. Eight claims, a mill-site, cyanide plant, aerial tramway, surface equipment, and buildings comprised the holdings of the Mother Lode Sheep Creek Mines Co. Seven claims and the disused mill were the visible assets of the original Nugget company. During 1919 the two companies were combined, the consolidation being known as the Nugget Gold Mines, Ltd.

Eleven miles of good road connect the cyanide mill, at creek-level, with the Great Northern railroad at Salmo. This wagon-road also serves the Queen, Kootenay-Belle, Reno, Ore-Hill, Vancouver, and other properties, as well as the settlement of Sheep Creek, 1½ miles below the road terminal. A trail from the end of the road at the Nugget mill opens up the interior for about 14 miles; pack-trains move supplies from this point to the Bayonne, Spokane, and other camps in the Bayonne district.

Veins and Enclosing Formation. The ore from the consolidated properties is an oxidized gold-bearing quartz; it is mined from the fault-fissures that intersect the alternating bands of laminated quartzite (known as the bee-hive); chlorite and quartz-schists comprise the local formation. The veins, seven in number, vary in strike from N. 20° E. to east and west, and dip from 70° E. to almost vertical. Two only of these veins have been mined or prospected. The orebodies are lenticular, varying in width from one to eleven feet, and with a maximum length of 210 ft.; they exist only in the quartzite; vein continuations through the schist-zones are uniformly barren. During 1920-1921, a cross-cut driven 1165 ft. in a northerly direction from a point inside the No. 5 level of the Mother Lode workings tapped the principal Nugget vein at a depth of 1050 ft. below the rim-rock, and 625 ft. below the deepest of the old Nugget workings.

Character of Ore. Oxidation persists to the present lowest level, at 1050 ft., but sulphides are found in places in the mine as pyrite, chalcopyrite, sphalerite, and galena. Pyrolusite coats the cleavage-planes in some of the vein-matter; the presence of malachite and native copper (in leaf form) sometimes causes trouble in metallurgical operations.

Development. About 6000 ft. of cross-cuts, drifts, shafts, and raises comprise former developments, mostly in the Nugget ground. A winze, sunk from the No. 5 level (Mother Lode) is down 150 ft. on the vein, with several hundred feet of drifting, both east and west from the shaft. The Nugget vein has been stoped 200 ft. above the car-tracks on level No. 5, and for a length of 210 ft. east and west from the cross-cut. A raise, continued 450 ft. on the vein, will connect with the deepest of the old Nugget workings, and is expected to expose a block of from 12,000 to 15,000 tons of good milling-ore. The precipitous character of the country permits the driving of a further series of cross-cuts, to cut the vein at required points between the No. 5 level and the lower tram-terminal, 1800 ft. below.

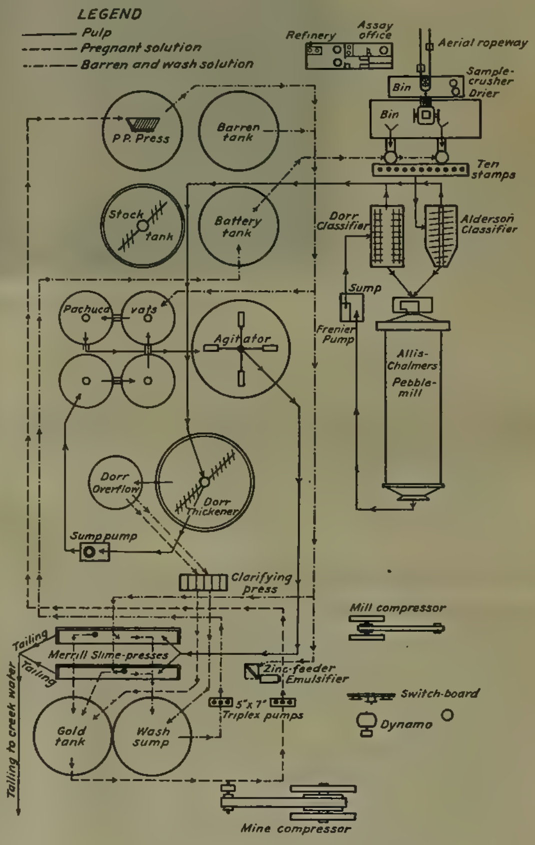
Aerial Tram Equipment. Level No. 5 (elevation 5325 ft.) is connected with the mill by 3800 ft. of aerial-tramway of the gravity type, carrying 18 self-dumping buckets, each of one-quarter ton capacity, and a set of timber-hooks. The tram-grade is approximately 30%, and 100 tons can be lowered to the mill in 8 hours. All mine-supplies and equipment are raised from creek-level to the lower terminal on an inclined tramway operated by an air-hoist. A new cable was placed in position, spliced, and the buckets re-hung in 40 hours last July.

Mill. The tram-buckets dump automatically into a 75-ton bin, whence the ore passes over an 8 by 3-ft. grizzley, the bars of which are spaced 1½ in. and are set at an angle of 60°. The undersize falls to the battery-bin, which has a capacity of 350 tons. The oversize is crushed in a Blake jaw-crusher (12 by 18 in.) to 1½ in. All labor in connection with crushing is performed by the tram-tender, on day-shift, whose other duties include the loading of supplies to the buckets and hooks, as well as the drying, cutting-down, and crushing of mine-samples to ¼ in. For this duty a wood-burning dryer and a sample-grinder operated by a small Pelton wheel are provided. Lime is added to the ore in the upper bin as required. Rack-and-pinion ore-gates and Challenge feeders control the flow of ore to the stamps.

The stamp-battery is of the South African pattern, with an individual water-line to each die—a feature that is not utilized. The ten 1050-lb. stamps drop 6½ in. at the rate of 100 per minute. Cams of the usual self-tightening type are used. Breakages are few; only one stem was broken during 1920. Square-opening ¼-in. mesh screens are used; these last from 15 to 20 days.

The ore is crushed in solution, the ore-solution ratio being 1 to 3; 60 to 65 tons passes through the stamp-mill per day of 16 hours, indicating a stamp-duty of 0.406 ton per hour. The discharge flows into an Alderson modification of the Akins classifier, the resulting overflow passing direct to a Dorr thickener. The coarse material, carrying 45% moisture, is sent to an Allis-Chalmers 5 by 20-ft. pebble-mill. The product from this flows to a sump, from which it is lifted by a Frenier pump to a Dorr duplex drag-classifier, the overflow passing to a Dorr 10 by 30-ft. thickener, with a capacity of 220 tons of water. The oversize is returned to the tube-mill.

Difficulty in procuring Danish pebbles compelled the use of substitute material from the mine-waste and from the hillside near the mill. This material gave trouble, and the use of it has prevented the attainment of maximum output. The overflow from the Dorr thickener is passed through a Merrill clarifying press of 10 frames; a pressure of from 4 to 8 lb. is used; from here it passes to sumps. The thickener product is lifted by a 3-in. centrifugal pump to the first of four Pachuca agitation vats, connected in series, and of an effective capacity of 20½ tons of water each; air at 30-lb. pressure is used. The density of the pulp may be reduced as required by adding barren wash. Agitation is continued for six to eight hours. 'Aero' brand cyanide is added to the first Pachuca; the cyanide strength is maintained at 1.1 lb. per ton, and the alkalinity at 0.3 lb. per ton. Extraction of gold and silver from the solutions is satisfactory. The slime from the Pachucas goes to a 20 by 10-ft. mechanical agitator, which serves as a reservoir, thence to the presses. The presses are of the usual Merrill type, each with 35 frames; they have a capacity of 85 cu. ft. each; 10-oz. canvas is used, the life varying according to the quality procurable. The pressure during filling varies from 18 to 22 lb.; the maximum wash-pressure is 32 lb.; air at 15-lb. pressure is used. A water-pressure of 60 lb. per square inch is maintained to discharge the residue. Periods of time for washing and air-displacement vary with the age and the condition of the cloth, and with the texture of the cake. The rich pregnant solution goes to the gold-sump; other solutions are elevated to the battery-tank, on the battery-floor, by means of a 5 by 7-in. triplex pump. The pregnant solution is pumped, by a second triplex pump of the same size, to a Merrill 10-frame 36-in. triangular precipitation press, placed at the top of the mill. The solution from this discharges to two



FLOW-SHEET OF NUGGET MILL

20 by 10-ft. sumps immediately beneath the press.

The precipitant used, 'merrillite', is fed by a screw-conveyor type of feeder to a 12 by 24-in. pebble-mill, where, after emulsification with barren solution, plus a drip of lead-acetate solution, it is fed to the triplex-pump suction, at the rate of 3.5 oz. per ton of solution. Eight tons of solution per hour is precipitated. During the final clean-up last October the pipe between the triplex pump at the foot of the mill and the precipitation press was taken down, and the incrustation removed by hammering. The precipitate recovered yielded $1600 in gold. Filter-paper is used on the press cloths. The air and solution pass through readily; the precipitated solution assays a trace almost up to the hour of the clean-up. The pressure in an empty press is from 5 to 6 lb.; in a loaded press, from 15 to 25 pounds.

A PACK-TRAIN IN BRITISH COLUMBIA

Cyanide and Pebble Consumption. The consumption, per ton of ore milled, equals NaCN, 1.55 lb.; CaO, 2.45 lb.; 'merrillite', 0.55 lb.; lead acetate, 0.002 lb.; quartzite pebbles, 20 lb. Extraction is from 97 to 98%.

Power. The plant is operated by eight Pelton wheels, impelled under a head of 650 ft. and a pressure of 350 lb., and developing a maximum of 400 hp. Water for power and all other purposes is secured from the north and south forks of Sheep creek, being brought to the mill through 11,000 ft. of 15-in. steel and stave piping. The available water-power depends, for duration and quantity, on climatic conditions, in this respect the results being unsatisfactory; the mill-runs seldom cover more than five or six months out of the twelve; the remainder of the time is lost, as aerial-tram operation is restricted to the capacity of the bin, when milling ceases. The plant is equipped with a 10 by 12-in. single-stage compressor, delivering air at 60 pounds.

Clean-ups are made at bi-monthly intervals; air at 60-lb. pressure is passed through the press till a moisture content of about 40% may be expected in the precipitate to be removed. The precipitate as removed from the press falls into a tray, on castors, that is placed directly beneath, and is carried from here to the refinery in fibre tubs. Each tubful is weighed, passed through a ½-in. sieve, and coned; when the cone is complete, the mass is pipe-sampled.

The refinery is equipped with a large English cupelling furnace, a power-agitated acid-treatment tank, a monteju, and a Merrill 12-leaf 24 by 24-in. clean-up press. A furnace, constructed on the property, is fired by two 2¾-in. Cary burners, supplied with gasoline as fuel; the pressure of air is 60 lb., and a No. 100 crucible is used. A block-and-tackle is used for hoisting and pouring the metal. Formerly, following Mother Lode practice, the crude precipitate was fluxed and melted direct, producing a base bullion with a fineness of 250 to 500 parts per 1000. The crucibles lasted one heat or less. This base bullion was unwelcome at the mint at Vancouver; the assays and controls failed to check. Since

THE NUGGET MILL

August last, acid-treatment has been adopted; the procedure at present consists of treating the precipitate with acid, filtering, washing, and air-drying the residue. About 1½ to 1¾ lb. of commercial sulphuric acid per pound of precipitate is used.

After drying, the precipitate is removed from the press, a moisture determination being made, and a flux is calculated.

A typical flux may consist of:

	Parts		Parts
Precipitate	100	Silica	20
Borax-glass	45	Calcium fluorspar	3
Sodium carbonate	18	Potassium nitrate	4

After thorough mixing, the mass is smelted. Slag and metal are poured into large conical molds; the resultant buttons are cleaned, weighed, sampled by hack-saw cuts for assay, and shipped. The bullion obtained carries from 700 to 825 parts of gold per 1000. The matte formed assays as follows: gold, 1760 oz. per ton; silver, 5250 oz. per ton; and copper, 44.5%. Matte and slag are shipped to the Trail smelter for treatment. All crucibles are pulverized through a 10-mesh screen and are rocked through a double-aproned cradle of the Nevada type, the extraction being practically complete after the first rocking. The mill-crew consists of a crusher-man (day shift), two battery-men, two solution-men, and three press-men, who act also as compressor-men; and the mill foreman. The staff includes Harold Lakes, superintendent; Arthur Lakes, geologist; George H. Shepherd, assayer and chemist; with Harry Gamble and Jack Chapman, mine and mill foremen, respectively.

Platinum

There have been no direct imports of platinum from Russia since 1919, states the 'Boston News Bureau', but Russian platinum is undoubtedly coming into the United States through England and, in a lesser degree, through Sweden. A trading agreement was made between England and Russia in February 1920; since April of that year there have been shipments of platinum to London. It is therefore of interest to note that during July, August, and September of this year, out of 7916 oz. imported from "other countries" 4293 oz. was from England. The subjoined table gives imports of platinum into the United States in troy ounces since 1911. The 1921 figures are for nine months:

Year	Russia	Colombia	Other countries	Total	Average price
1921	......	22,538	20,787	43,325	....
1920	......	28,757	54,124	82,881	$110.90
1919	30,000	35,000	2,180	67,180	114.61
1918	25,000	35,000	2,283	62,283	105.95
1917	50,000	32,000	1,067	83,067	102.82
1916	63,000	25,000	1,041	89,941	83.40
1915	124,000	18,000	1,163	143,163	47.13
1914	241,000	17,500	1,848	260,348	45.14
1913	250,000	15,000	2,233	267,233	44.88
1912	300,000	12,000	1,529	313,529	45.55
1911	300,000	12,000	1,128	313,128	42.12

The production of Colombia has been on the increase during the third quarter of this year. Imports from Colombia during the first six months of 1921 averaged 2244 oz. per month. Imports from Colombia for July, August, and September were 2985, 2126, and 3961 oz., respectively. Prices this year have been erratic, ranging from $58 to $79 per ounce. The surprisingly large quantity received from other countries in 1920 was derived from the unloading of scrap accumulated by European governments. The United States government has also sold 13,915 oz. of platinum since the Armistice at $105 per ounce. When this platinum was purchased in war-time an average price of $105 was paid. The trade was practically compelled to sell stocks to the Government; and, under the circumstances, the Government thought it right to give a pledge that in event of unloading after the War the selling price would not be over $105. In this way trade demand has been met, but not in a measure approaching the pre-war consumption. Normal consumption in the United States is 160,000 oz. per year. Of this less than 60,000 oz. is re-issued scrap. Thus normal demand for new platinum exceeds 100,000 oz. As previously shown, supply of new platinum is less than that. Unlike European countries, 60% of United States consumption is for jewelry. Demand for platinum jewelry has decreased enormously. Therefore, diminished supply has met demand, and price still remains at $85 per ounce. Present holdings of the War Department will not be sold unless existing policies are changed. All former belligerent governments are holding stocks of platinum for strategical reasons. It is expected any future war would be fought largely with chemicals, and platinum is indispensable for their catalysis.

Reckoning as new platinum the imports from Colombia, England, Sweden, and Canada during September, the present supply is shown to be 6237 oz. per month, or 74,844 per year. This compares favorably with imports of new platinum at any time since 1917. With more efficient dredging operations shortly to be initiated in Colombia and the pressing need of the Soviet government to establish credits abroad, production may be expected to increase. Under normal industrial conditions Russian placer mines will be exhausted within 15 years, but the present rate of 10% of pre-war production is no criterion of actual potentiality. Several attempts to finance the industry have been made during the War and since the War. In 1916 the National City Bank of New York offered $15,000,000 for the control of one mine. This move came to nothing. In 1917 a French bank offered $25,000,000 for a 50% interest of all the mines. The offer was accepted by the Kerensky government. Corporation stock was sold, and mining was started. Then came the Bolsheviki and confiscated the mine and nationalized the industry. Afterward they tried to negotiate with Americans, but no trade resulted.

The trade with England of February 1920 affects concessions and exports only. British imports into Russia have actually fallen since the agreement from 14% of the total to 8%, whereas American imports have increased from 35% to 70%. But England is getting the Russian exports, including platinum, although Russia is not sticking to her bargain. Gold concessions are being offered elsewhere. If the United States will not take them, they are likely to fall into the hands of Japan.

Mining in Alaska in 1921

[*]The value of Alaska's mineral output in 1921 was about $16,109,000, as compared with $23,303,757 in 1920. This was the lowest annual value since 1904. The decrease was due to a decline in all forms of lode mining, especially that of copper, for the output of the gold placers was somewhat larger than that of the preceding year, and a little progress was made in the development of the coalfields. The stagnation of Alaskan mining is but a reflection of the world-wide depression of the industry and is not caused primarily by local conditions.

Value of Minerals Produced in Alaska in 1920 and 1921

	1920	1921
Gold	$8,365,560	$8,000,000
Copper	12,960,106	6,971,000
Silver	1,039,364	466,000
Lead	140,000	46,000
Platinum and allied metals	160,117	5,000
Tin	16,112	1,000
Coal	355,668	480,000
Petroleum, marble, gypsum, quicksilver, etc.	266,830	140,000
	$23,303,757	$16,109,000

The dominant features of the year's mining are (1) the decrease of both copper production and development work, owing to the low price of the metal; (2) the closing of the Perseverance mine, one of the three auriferous lode mines at Juneau; (3) continuation of activity in auriferous quartz prospecting in the Sitka, Juneau, Salmon River, and Willow Creek districts; (4) a revival of placer mining; (5) continuation of systematic prospecting for coal in the Matanuska field by the Naval Coal Commission; (6) the many examinations made in Alaskan petroleum fields by oil companies, with the purpose of drilling. The discovery of a new deposit of galena and other sulphide ores in the Kantishna district is worthy of special note.

The Kantishna district, just north of Mount McKinley, has long been the scene of a little placer mining, as well as of small developments of gold- and silver-bearing lodes. Two years ago a galena deposit was opened up, and since then about 1100 tons of ore has been shipped. The district is 50 to 70 miles west of the Alaska railroad, but it has no road connection with that line, and the ore had to be transported by horse-sleds to Kantishna river and thence by small steamers to the Tanana. This method was so expensive that only the richest ore could be mined. Therefore the galena ore was hand-picked, the grade of shipments being thus brought to an average of about 182 oz. of silver and $3.20 in gold, in addition to the lead and copper. The lode from which this ore came and others near-by are at or near Eureka creek. The deposits lie in well-defined fissures traversing schistose rocks, and are associated with granitic intrusives. Some of the orebodies are 8 to 15 ft. wide, but the rich galena is in shoots from 6 in. to 2½ ft. wide. Gold-bearing quartz veins of similar type are also found in this part of the district, as well as some deposits of antimony (stibnite). The few openings made indicate that the lodes are fairly persistent along the strike.

In 1921 sulphide-bearing lodes were discovered in the foothills of the Alaska range, 20 miles south-east of Eureka creek in the Kantishna district, by O. M. Grant and F. B. Jiles, who staked 22 claims. They lie some 14 miles from timber, but lignite beds are close at hand. They are readily accessible to pack-horses. The construction of about 50 miles of wagon-road would connect the locality with the Alaska railroad at Riley creek. Granodiorite is the prevailing country rock of the region and is found both in large areas and as dikes. Banded and massive quartzites, with some limestones and slate cut by granodiorite dikes, constitute the formations in which the ores have been found. The sedimentary beds are much deformed and trend a little north of west.

The orebodies are distributed through a zone that trends a little north of east and thus apparently cuts across the bedding of the sediments. It has been traced about two miles and is reported to be longer. As determined by present discoveries, its width is from one-fourth to one mile wide. This zone is characterized by an abundance of sulphide minerals, concentrated in well-defined orebodies; some of these have definite walls; in others the ore grades into the country rock. They occur chiefly in the quartzites, but some are in the granodiorite and others at the contact between the two. As no excavation has been done it is difficult to give exact statements as to width. At some places there is evidence of sulphide mineralization over a width of about 100 ft., but in these places the rich sulphides appear to be limited to certain shoots. Most of the lodes are much smaller and consist of shoots in zones 10 to 25 ft. wide. The ore consists chiefly of galena, chalcopyrite, zinc-blende, iron pyrite, and bornite; galena seems to dominate. A granular intergrowth of galena with chalcopyrite evidently forms the typical ore, but larger masses of pure galena are also found. The gangue consists of quartz, and the country rock is chiefly quartzite. In the absence of sampling, or even of cuts exposing the ore, a definite statement of metallic content is not justified. The grab-samples taken by owners of claims have yielded from 0.2 to 270 oz. of silver and from a trace to $8 in gold per ton. Three samples carried from 1.17 to 8.87% copper. No work had been done on the Grant and Jiles claims when they were examined, nor on the other prospects reported in the same region. Their value cannot be predicted, but the surface exposures fully justify careful prospecting.

GOLD PLACERS. Alaskan placer mines produced gold to a value of about $4,090,000 in 1921 and $3,873,000 in 1920. This increase is to be credited chiefly to the Kuskokwim placer districts. At the end of 1921 the Alaskan mines had produced a total of $328,000,000 worth of gold, of which $222,000,000 came from placer mines. A number of new finds of placer gold were made during 1921, but these were all in known fields of auriferous alluvium. The most promising of these discoveries is on Wilbur creek, a tributary of Tolovana river, about seven miles due east of Livengood creek. The finding of coarse gold on this creek indicates that there may be a second belt of mineralization in the Tolovana area. Another deposit of placer gold was found on Kokomo creek, a southerly tributary of Chatanika river, 10 miles east of Cleary. This discovery is significant chiefly because it indicates an eastern extension of the auriferous area. In 1921 placer mining was begun on gold prospects that had been found in 1918 on Stuyahok creek, a tributary to Bonasila river, which flows into the Yukon 10 miles below Anvik.

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[*] **Advance statement by U. S. Geological Survey.**

Returns on dredge production, especially from Seward Peninsula, are as yet incomplete, but it appears that 22 dredges were operated in 1921 and recovered about $1,500,000 worth of gold. In 1920 the same number of dredges produced gold to the value of $1,130,000. The increase in dredge-gold production in 1921 is to be credited to the eight dredges outside of Seward Peninsula—two each in the Fairbanks and Iditarod districts, and one each in the Innoko, Circle, Yentna, and McGrath districts. The most successful dredge in 1921 was on Candle creek, in the McGrath district.

The average gold recovery by dredging in the Yukon and Kuskokwim districts in 1920 was 96c. per cubic yard, whereas that of Seward Peninsula was only 48c. This difference alone will account for the search for dredging-ground being directed largely to inland Alaska, where the richest dredging-placers have been developed. The Kuskokwim basin has been especially investigated for dredging-placers, but during 1921 considerable attention has been given to the development of dredge mining in the Fairbanks, Rampart, and other Yukon districts. The facilities for communication provided for inland Alaska by the completion of the Government railroad and the increase of wagon-roads will give further impetus to dredge mining. Cold-water thawing, now being so successfully used by many widely distributed Alaskan dredges, greatly reduces fuel consumption, and is thus an important element in economical operation. The Seward Peninsula dredges are now working under an enormous handicap of high fuel cost. In 1921 the cost of coal at Nome was $35 per ton, and that of coal delivered at the placer mines was probably on an average at least $50 per ton. In comparison with this, many of the inland dredges are paying from $8 to $15 per cord for wood. No doubt an increase of business and the completion of the harbor for scows will lower the cost of freight at Nome and, together with the building of a wagon-road, will decrease the cost of land transportation. Another project to lower dredging costs on Seward Peninsula, however, will always be hampered by the fact that the first steamers in summer do not arrive until at least a month after the dredging season opens. Eventually this situation will be relieved by an automobile road giving communication with the Government railroad. In spite of the present handicaps, dredge mining will increase on Seward Peninsula. It is to be expected that the advances will be made by large companies operating many dredges, with power furnished by central stations run by hydro-electric power or fuel. An experienced operator estimates the operating cost of dredging on Seward Peninsula, with cold-water thawing, as low as 18c. per yard, even under present adverse conditions. There can be no question of a large expansion of the present gold-dredging industry of Alaska.

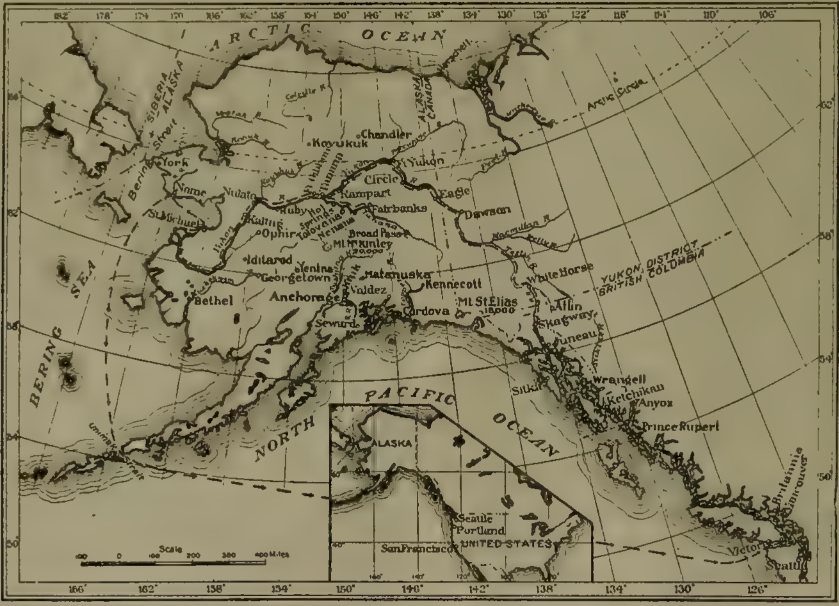
Value of Placer Gold Produced in Alaska in 1920 and 1921

	1920	1921
Pacific Coast region:		
Copper River	$201.105	$215.000
Cook Inlet and Susitna Basin	55.432	180.000
All other districts	10,091	4,000
	$266.628	$399.000
Yukon Basin:		
Fairbanks district	$584.218	$460,000
Iditarod district	508.954	500.000
Tolovana district	200.893	270.000
Ruby district	171.213	150.000
Circle district	55.506	100.000
All other districts	488,284	376.000
	$2,009.068	$1.856.000
Kuskokwim region	309.320	550.000
Seward Peninsula and north-western Alaska	1.315.474	1,285.000
Grand total	$3,900.490	$4.090.000

GOLD QUARTZ MINING. Four large and about twenty small auriferous lode mines and prospects in Alaska produced about $3,900,000 worth of gold in 1921. In 1920, seventeen gold-lode mines and five prospects produced $4,473,687 worth of gold. This decrease of output is chargeable to the closing of the Perseverance mine, near Juneau, on June 1. Since the beginning of Alaskan gold-lode mining this industry has produced about $100,000,000 worth of gold, of which $80,000,000 came from the large low-grade deposits of the Juneau district. Under the present high cost of operation, interest in this form of mining has declined, and attention is being given to the smaller deposits carrying ore of higher value. Although mining in the Juneau district has declined, there is still much systematic prospecting of gold-bearing veins in the region, notably on Admiralty island. The Chichagof mine, in the Sitka district, made about its normal output during 1921, and there was much active development of auriferous lodes in the adjacent region. Work was also continued at the Kasaan gold mine, in the Ketchikan district. Important advances were made in prospecting gold- and silver-bearing lodes of the Salmon River district, in the Portland Canal region. Small shipments of ore were made from this district. A little gold-quartz mining was carried on in the Valdez district of Prince William Sound and in the Hope district of Kenai Peninsula.

The Willow Creek district, tributary to Anchorage, produced about $100,000 worth of lode gold. This came from seven small mines, many of which are equipped with mills more remarkable for their novelty than for their efficiency. The lodes of the district occur in well-defined fissures traversing dioritic rocks. Most of these veins are remarkably persistent, though some are faulted. Within these lodes are rich ore-shoots, and mining has been limited to the search for and extraction of the rich ore from these shoots. In general the lodes have not been systematically developed to block out an ore tonnage, owing to lack of technical knowledge and of sufficient capital for the work undertaken. As a consequence most of the mines are being worked on a hand-to-mouth basis. Plans have been formulated for larger-scale operations, and above all for more systematic exploration of ore-bodies. The surface indications more than warrant the careful underground exploration of the lodes already discovered.

Quartz mining at Fairbanks is still limited to the prospecting of some small lodes relatively rich in gold. Gold ore taken from five or six different properties was mined and milled. Between $30,000 and $40,000 worth of gold was recovered from these operations; the largest developments were on the Smith & McGlone property. The Alaska Treadwell Co. continued systematic exploration of its gold-lode mines in the Nixon Fork basin of the upper Kuskokwim region. In connection with this development work some ore carrying gold, silver, and copper was mined and shipped by river and ocean boats. The outlook has been found sufficiently encouraging to justify the installation of a small reducing plant for the treatment of this ore.



MAP OF ALASKA

Copper Mining. In 1921 the Alaska mines produced about 56,214,000 lb. of copper, valued at $6,971,000, as compared with 70,435,363 lb., valued at $12,960,106 in 1920. In 1921 the copper production came almost entirely from the three large mines of the Kennecott group, in the Chitina basin; the Beatson-Bonanza, on Prince William Sound; and the Rush & Brown mine, in the Ketchikan district. There was little exploration for copper ore during the year, but work was continued at the Dickey and McIntosh properties, on Prince William Sound, and on other claims in several districts. It is reported that a rich ore-shoot of chalcocite was uncovered by J. E. Barrett on the Green property, on McCarty creek, in the Chitina basin.

Miscellaneous Metals. The Alaskan mines produced about 742,000 oz. of silver in 1921 and 963,546 oz. in 1920. The silver was produced chiefly as a by-product of gold and copper mining, hence the output declined with that of these other metals. Some of the silver produced came from galena ores, of which about 450 tons was mined in 1921. The Alaska lead output, derived from gold and galena ores, was about 510 tons in 1921, as compared with 875 tons in 1920. Owing to the low price of tin, the mining of that metal in Alaska almost ceased in 1921, and the total production is estimated to have been only about 1½ tons, as compared with 16 tons in 1920. No tin was shipped, and the output came chiefly from the Hot Springs district of the Tanana region, where it was recovered incidentally to gold-placer mining.

No reports have been received of any mining during 1921 in the York district of Seward Peninsula, which in the past was the principal source of Alaskan tin. Work was suspended during 1921 at the Salt Chuck palladium-copper mine. As this property was the principal source of the platinum and allied metals produced in Alaska, the total output of these minerals was only about 65 oz. in 1921, as compared with 1479 oz. in 1920. The platinum output in 1921 was all derived from gold-placer mining mainly on Dime creek, on Seward Peninsula. Two quicksilver properties were under development in Alaska during 1921—the Parks mine, on lower Kuskokwim river, and the Swift mine, 20 miles south-west of Iditarod. Some quicksilver was produced at the Swift mine. No antimony, tungsten, chromite, or molybdenite was mined in Alaska during 1921.

Lead and Zinc During 1921

By C. E. Siebenthal and A. Stoll

*The output of lead from mines and smelters in the United States during 1921 fell off about 20%; that of zinc declined nearly 60%, according to reports and estimates by producers and others. Data for the Western States are taken from the advance statements issued by the Geological Survey's Western offices. Statistics of imports and exports are taken from the records of the Bureau of Foreign and Domestic Commerce for 11 months, and an estimate is made for December.

Mine Production of Lead. The output of soft lead by mines of the Mississippi Valley was about 231,000 tons, and that of argentiferous lead by mines of the Western States was about 170,000 tons, a total of 401,000 tons. The corresponding figures for 1920 are 251,816 tons from the Mississippi Valley (including the small output of the Eastern States) and 259,070 tons from the Western States, a total of 512,865 tons. The South-Eastern Missouri district made the largest output and was the only district to make a gain. Its output was 178,000 tons, as compared with 161,258 tons in 1920. The Coeur d'Alene district of Idaho came next, with about 96,000 tons, as against 118,105 tons in 1920. Utah output was about 45,000 tons, a decrease from 70,419 tons in 1920. The imports of lead in ore were about 7000 tons, furnished chiefly by Canada, Mexico, and South America, and those of lead in bullion were about 41,000 tons, almost wholly from Mexico, as compared with a total of 62,796 tons in 1920. The lead content of lead ore in bonded warehouses on November 30 was 7648 tons and of base bullion 16,207 tons, as against 16,462 and 34,758 tons, respectively, in 1920. Part of this lead, however, may have been smelted or refined but not shipped and thus may be included in smelter stocks.

Mine Production of Zinc. The recoverable zinc content of ore mined in 1920 was about 250,000 tons, as compared with 584,772 tons in 1920 and 549,242 tons in 1919. The output of the Eastern States was 68,000 tons, that of the Central States about 168,000 tons, and that of the Western States 14,000 tons, as compared with 102,242, 337,652, and 144,878 tons, respectively, in 1920. The loss in output of the Eastern States was one-third, that of the Central States one-half, and that of the Western States over nine-tenths. The Upper Mississippi Valley region is credited with an output of about 4000 tons and the Joplin district with an output of about 164,000 tons. Oklahoma made the largest output, about 116,000 tons, twice as large as that of any other State. In 1921 Montana (the Butte district almost wholly) apparently produced about 11,000 tons, as compared with 91,906 tons in that district in 1920.

The imports of zinc in ore decreased from 22,487 tons in 1920 to about 2700 tons in 1921, most of which was imported from Mexico. The zinc content of zinc ore in bonded warehouses on November 30 was 14,292 tons, as compared with 25,650 tons at the end of 1920. Some of this ore may have been smelted but not shipped and thus may be included in smelter stocks.

Early in January zinc concentrate containing 60% zinc was selling in the Joplin district at $28 per ton, having dropped from $60 per ton at the beginning of 1920. The price dropped to $21 by the beginning of March, rose to $26 by the beginning of May, dropped to $21 by the middle of June, and remained at that point until late in August, when it reached bottom at $20 per ton. Through the last quarter of the year there was a considerable improvement in price and at the end of the year concentrates were selling at $28 to $30 per ton.

It would be natural to suppose that zinc smelters, with Joplin concentrate selling for $20 per ton, would stock up fully. However, if the output of domestic primary zinc, 194,000 tons, is subtracted from the mine production of recoverable zinc, 250,000 tons, 56,000 tons is left to furnish the zinc content of pigments. But pigments made in 1920 contained 110,695 tons of zinc, and the output of pigments in 1921 was probably not greatly below that of 1920. Apparently, therefore, smelter stocks of concentrate were depleted rather than increased in 1921.

The lack of demand led to considerable storage of concentrates at mines, and the stocks of concentrate in the Joplin district are estimated at about 70,000 tons and those in the Upper Mississippi Valley region at about 25,000 tons, figured at 60% concentrate. Stocks in other districts would probably bring the grand total for the country to 150,000 tons. Even so, this quantity is small in comparison with the stocks of Australian zinc concentrates, which were reported recently as 700,000 tons, containing about 47% zinc. The Rhodesia Broken Hill district of Africa is credited with stocks of zinc ore amounting to nearly 50,000 tons.

Refinery Production of Lead. The output of primary domestic de-silverized lead in 1921 was about 190,000 short tons of soft lead about 145,000 tons, and of desilvered soft lead about 55,000 tons, making a total output from domestic ores of about 390,000 tons of refined lead, as compared with 476,849 tons in 1920, which was made up of 220,327 tons of de-silvered lead, 189,854 tons of soft lead, and 66,668 tons of de-silverized soft lead. The output of lead smelted and refined from foreign ore and bullion was about 50,000 tons, as compared with 52,808 tons in 1920. The total lead smelted or refined in the United States was thus about 440,000 tons, as compared with 529,657 tons in 1920. The output of antimonial lead was about 8000 tons, as against 12,535 tons in 1920. The exports of lead of foreign origin were about 33,000 tons and of lead of domestic origin about

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*From U. S. Geological Survey.

700 tons, as compared with 23,538 tons and 2730 tons, respectively, in 1920, an increase of about 7000 tons in the total exports. The imports of refined pig-lead, which for the years 1916 to 1919, inclusive, had been a little over 5000 tons per year, and which had jumped in 1920 to 35,719 tons, maintained that high level in 1921, being about 32,000 tons. These heavy importations were the result of the relations between the New York and European prices and the rates of exchange.

Smelter Production of Zinc. The output of primary metallic zinc from domestic ores in 1921 was about 194,000 tons and from foreign ores about 2500 tons, a total of 196,500 tons, as compared with 450,045 tons from domestic ores and 13,332 tons from foreign ores, a total of 463,377 tons in 1920. In addition to primary zinc there was an output of about 17,000 tons of re-distilled secondary zinc, as compared with 21,371 tons in 1920, making a total supply of distilled zinc and electrolytic zinc in 1921 of 213,500 tons, of which 31,500 tons was high-grade and intermediate, 32,000 tons select and brass-special, and 150,000 tons prime Western. The output of the corresponding grades in 1920 was 114,606, 59,811, and 310,331 tons, respectively, a total of 484,748 tons. Of the total output of primary zinc in 1921, about 48,000 tons was made in Illinois, as against 109,056 tons in 1920; 40,000 tons in Oklahoma, as against 110,500 tons; and 36,000 tons in Pennsylvania, as against 74,234 tons.

The imports of foreign slab-zinc amounted to 6674 tons, as compared with 15 tons in 1920. Of these imports, England furnished 4200 tons, Germany 1456, Netherlands 560, and Belgium 452. The condition of the world market in the last four months of 1920, which permitted the sale in the United States of domestic zinc that had been previously exported, continued through the first quarter of 1921, during which period 731 tons of zinc was returned, as against 8162 tons in 1920. Not included in the imports given above is 6529 tons of sheet-zinc imported and entered for consumption in the first nine months of 1921. But a few hundred tons of sheet-zinc has been imported annually heretofore, and but a few tons since 1915.

The exports of zinc made from foreign ores were about 1260 tons and those of zinc made from domestic ores were about 3200 tons, as compared with exports of 28,368 and 85,898 tons, respectively, in 1920. The exports of domestic zinc included about 1800 tons of sheet-zinc, as against 11,852 tons in 1920. The stocks of zinc at smelters and in warehouses at the end of November was 74,000 tons, as against 94,747 tons on June 30, 1921, and 71,037 tons at the end of 1920. The apparent consumption of primary zinc during 1921 was about 196,000 tons, as compared with 323,044 tons in 1920.

At the end of November, 38,700 retorts were reported in operation out of a total of 150,462 retorts, as compared with 36,000 out of 123,528 on June 30, 1921, and with 56,197 out of 158,625 at the end of 1920. Advices late in December put the number of retorts expected to be in operation at the end of the year at about 41,500, or a little more than one-fourth of the total.

The average quoted price for prime Western zinc for immediate delivery at St. Louis in 1921 was nearly 4.7c. per pound, as compared with an average selling price for all grades of 8.1c. in 1920. The price of prime Western zinc began the year at 5.6c. in the St. Louis market, but had declined nearly to 4.6c. by the middle of April. After a slight recovery the price continued to decline until 4.5c. was reached at the mid-year. After remaining practically stationary for three months, the price rose through the last quarter of the year and closed at about 4.7c. From the middle of May until the last of October the average weekly quotation for prime Western zinc was lower than that for lead. The two largest zinc-rolling mills have added zinc-shingle machinery to their equipment.

Foreign Lead and Zinc Industry. The output of refined lead in Canada in 1921, estimated from the year's output in British Columbia and 9 months output in Ontario, was about 30,000 tons, as compared with 14,360 tons in 1920. Burma and Rhodesia, as estimated from the output for 9 months of the year, produced about 36,000 and 19,000 tons, respectively, in 1921, as against 26,680 and 16,354 tons in 1920. The best information available indicates that the world's output of work-lead was a little over 800,000 metric tons, of which the United States smelted 40%, as against 900,000 metric tons in 1920, of which the United States smelted nearly 50%.

The output of electrolytic zinc in British Columbia in 1921 is given at 26,500 tons, as compared with 16,798 tons in 1920. The zinc smelter output of Belgium, in 1921, as estimated from the output for 10 months was about 70,000 tons, as against 92,880 tons in 1920. The world's smelter output of zinc in 1921 is estimated at about 400,000 metric tons, of which the United States smelted 45%, as against a little over 700,000 metric tons in 1920, of which the United States smelted 60%.

The labor strike at Broken Hill, in May 1919, compelled the great lead smelter at Port Pirie, Australia, to close in July 1919, for lack of ore. It started up again after the strike settlement in November 1920, but the sintering plant was destroyed by fire in January 1921, compelling the smelter to close again. The reconstructed sintering plant which was completed in August 1921 has but one-half its former capacity, so that a similar reduction is entailed in smelting capacity, amounting to about 70,000 tons annually.

The Burma Corporation has discontinued the erection of the new lead smelter, which was planned to have a capacity of 60,000 tons, and will extend and improve the existing plant so that it will have a capacity of 45,000 tons annually. Likewise, the plans for a zinc smelter near Calcutta have been abandoned for the present. Half of the Risdon (Tasmania) electrolytic-zinc plant, which has a rated capacity of approximately 20,000 short tons, was started in December 1921. It is expected that the other half will be completed by the end of 1922. As a result of the award of the League of Nations, Poland will make 86% of the production of zinc ore and 77% of the production of lead ore.

Company Reports

DAVIS-DALY COPPER COMPANY

Report for the year ended June 30, 1921.

Financial: Receipts, $1,333,193.28; disbursements, $1,412,310.39; net operating loss, $411,113.76.

Development: 3.2 miles.

Production: 128,960 tons, producing 8,456,062 lb. copper, 1,463,182 oz. silver; 2608.214 oz. gold; 2,127,290 lb. lead; and 5,060,368 lb. zinc.

SANTA GERTRUDIS COMPANY

Report for the year ended June 30, 1921.

Holdings: The company's holdings in the Cia. de Santa Gertrudis and the Cia. Beneficiadora de Pachuca remain unaltered. The company also holds shares in other Mexican properties.

Financial: Receipts plus balance brought forward, £30,531 0s. 9d.; balance carried to balance-sheet, £453 4s. 4d. During the period under review an issue of £300,000, 8%, 5-year notes was made.

General: The directors report with regret the resignation of W. J. Cox as the company's advisory engineer.

AMALGAMATED ZINC (DE BAVAY'S)

Report for the half-year ended June 30, 1921.

Property: Tailings treatment plant in Australia.

Financial: Receipts by sale of concentrates and sundries, £150,934 19s. 5d.; balance to profit and loss account, £127 0s. 11d.

Production: 128,646 tons of tailing was treated for a yield of 37,201 tons of zinc concentrates and zinc-slime concentrates, assaying 46.4% zinc, 7.9% lead, 13.8 oz. silver; also 815 tons of lead concentrate and lead-slime concentrates, assaying 49% lead, 39.2 oz. silver, and 18.1% zinc.

General: Reduced output was due to the non-delivery of tailing, under agreement, from the Broken Hill South properties.

DE BEERS CONSOLIDATED MINES

Report for the year ended June 30, 1921.

Property: Diamond mines and plants in South Africa.

Financial: Suspense profit account, plus sundry income, £4,542,336 18s. 8d.; expenditure, £2,711,507 5s. 9d.; balance, £1,830,829 12s. 11d.; dividends, £1,240,000; balance undistributed, £464,731 16s. 11d.

General: The directors report that for several months during the year there was a cessation of diamond sales. Operations have been curtailed and economies effected, which unfortunately necessitated the retrenchment of large number of employees. The company, however, has paid to the preference shareholders the usual dividend of 20 shillings and to deferred shareholders, 10 shillings per share.

EL ORO MINING & RAILWAY COMPANY

Report for the year ended June 30, 1921.

Property: Mines, mills, and railway in Mexico.

Financial: Net profit, £74,383 3s. 6d.; dividends, £57,375.

Production: 383,043 tons of ore was treated of a gross value of $7.63; bullion produced realized $2,545,446.

General: General and economic conditions in Mexico have shown improvement, it is stated. In consequence, and in conjunction with further economies at the mine, due to extremely watchful management, working costs have been reduced by about $1 per ton. This has rendered it possible to maintain an average rate of profit per ton of ore, and at the same time to bring under treatment ore of lower grade. Taxation remains oppressive. The sum paid for State and Federal taxes in Mexico amounted to $333,297. The net earnings from the operation of the company's railway during the year amounted to $203,526. The company's officials are to be congratulated on the appearance of an informative and frank statement of theoretical extraction of gold and silver, as compared with actual recovery.

CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA

Report for the year ended June 30, 1921.

Holdings: Shares to the value of £4,500,000 in the New Consolidated Gold Fields company, which in turn is a holder of stock in a large number of British and American companies.

Financial: Income, £3608 6s. 5d.; balance from previous year, £162,635 12s. 3d.; dividends paid, £108,901 6s. 5d.; amount to credit of present years profit and loss account, £57,342 12s. 3d.

General: The manager of the New York advisory committee states that, world conditions during the year being unfavorable to the inception of any mining business of magnitude, the company has confined itself to taking, at a small cost, interests in several promising ventures in which a large or dominant interest may be secured ultimately.

CIA. BENEFICIADORA DE PACHUCA

Report for the year ended June 30, 1921.

Property: Mines and mill at Pachuca, Mexico.

Operating Staff: C. A. Lantz, general manager; F. H. Walsh, general superintendent; W. E. Crawford, milling superintendent.

Development: 14,295 ft. at El Bordo, and 2362 ft. at Malinche; ore-reserves, 1,319,617 tons, containing 61,543 oz. gold and 14,651,459 oz. silver.

Production: Crushed and treated by cyanide, 475,360 tons. Bullion recovered contained 21,680 oz. gold and 4,533,338 oz. silver.

General: The extension of the milling plant from 1500 to 2000 tons per day was commenced and nearly completed; work was suspended last February when the power-shortage developed. The work completed included the extension of the crusher building, and the preparation of the foundations for primary and secondary crushers; extension of the mill building, to accommodate two additional 8-ft. ball-mills; the installation of a 300-leaf vacuum filter plant; and the addition of miscellaneous pumping and other equipment.

BURMA CORPORATION

Report for the year ended December 31, 1920.

Financial: Receipts from sales of lead and silver, sundry profits and receipts, £1,206,757 6s. 8d.; balance to appropriation account, £455,516 3s. 5d.

Ore-reserves: Ore-reserves as at December 31, 1919, 4,402,218 tons containing 23.9 oz. silver, 25.7% lead, 17.9% zinc, and 1.2% copper.

Development: 3648 feet.

Smelter Operations: Tons smelted, 136,450; lead, 29.57%; silver, 26.72 oz.; zinc, 15.5%; hard lead produced, 28,484.7 tons; refined lead produced, 23,821.14 tons; fine silver produced, 2,869,727.24 ounces.

General: The directors decided to stop the construction of the zinc works in India, as financial considerations prevented the Government of India from contributing the anticipated loan, and the Tata Iron & Steel Co. desired to limit its participation. They also decided to discontinue the erection of the new lead smelter, and to rely on extension and improvement, at a much smaller cost, of the existing smelter. All further expenditure on the Namma coalfield will be stopped. The present program is based on an annual output of 45,000 tons of refined lead and 4,500,000 oz. silver.

REVIEW OF MINING

NOTICE TO CALIFORNIAN MINE SUPERINTENDENTS

Byron O. Pickard, district mining engineer for the U. S. Bureau of Mines, stationed at Berkeley, California, desires to notify superintendents of mines in California of the most desirable method of communicating with the Bureau in the event that assistance of the Mine Rescue Service is desired in case of disaster. The preferable method is to use the long-distance telephone, endeavoring to get the following numbers:

B. O. Pickard, (office hours) Berkeley 7100
B. O. Pickard, (after hours) Piedmont 2124-J
A. C. Moore, Berkeley 4071-J
Dr. C. E. Kindall, Berkeley 7780-J.

It is advised that the above numbers be tried in the order given. If it is necessary to use the telegraph, it is requested that as much detail as possible be given in order that the officials of the Bureau may intelligently plan and route the rescue crew. Telegrams addressed to Mr. Pickard, care of the Bureau of Mines, will be delivered at his home after office hours, but it is urged that the telephone be used.

COPPER STATISTICS FOR 1921

The smelter production of copper in 1921 from ore mined in the United States, as shown by the actual production for the first 11 months and by estimates made by smelting companies for December, was about 461,000,000 lb., according to the U. S. Geological Survey. The refinery production as similarly shown was about 601,000,000 lb. from domestic material and about 320,000,000 lb. from foreign material. The exports for the first 11 months totaled about 567,000,000 lb., of which about 538,000,000 lb. was new refined copper and 29,000,000 lb. was manufactured.

The total new supply of primary refined copper for the year was about 989,000,000 lb., which includes refined copper produced from foreign and domestic material as well as imported refined copper. The stocks of refined copper in the hands of domestic refineries on December 31, 1921, excluding those in transit, as estimated by the refining companies, were about 496,000,000 lb. The stocks of blister-copper on December 31, 1921, including material in process, in the hands of smelters, in transit to refineries, and at refineries were estimated by refining and smelting companies at about 297,000,000 pounds.

The quantity of primary refined copper withdrawn on domestic account during the year was about 572,000,000 lb., calculated as follows:

	1920	1921
Refinery production from domestic sources..	1,182,000,000	601,000,000
Refinery production from foreign sources....	344,000,000	320,000,000
Imports of refined copper................	109,000,000	75,000,000
Stocks of new refined copper on January 1..	631,000,000	659,000,000
Total available supply	2,266,000,000	1,655,000,000
Exports (exclusive of manufactured copper).	553,000,000	587,000,000
Stocks on hand on December 31...........	659,000,000	496,000,000
	1,212,000,000	1,083,000,000
Total withdrawal on domestic account....	1,054,000,000	572,000,000

HEARINGS ON PROPOSED MINING ACT TO START AT WASHINGTON

Hearings are scheduled to start this month before the House Committee on Mines and Mining on the bill introduced by Representative Samuel S. Arentz of Nevada "to revise, amend, and codify the laws of the United States relating to the location of mining claims on the public domain, and for other purposes". Arentz says that codification of laws relating to mining claims has for several years been recognized as a necessity by the Bureau of Mines and by the legal fraternity. Existing laws, he states, are widely scattered and fragmentary, and date from the California gold rush of 1849. A preliminary conference on the bill recently was held by Arentz with H. Foster Bain, Director of the Bureau of Mines, other officials of the Bureau, and Senators and Congressmen.

Arentz, who is a mining engineer, has approximately 200 communications, resolutions, and memorials from associations of engineers, miners, and prospectors from various parts of the West, most of which condemn the bill. The Bureau of Mines also has received many letters in support of the measure. While primarily a codification, it proposes some radical changes in existing laws. Prominent among these changes are the abolition of the mooted 'apex' or 'extra-lateral rights' law, location without discovery, and the option of cash payments into the United States Treasury in lieu of annual assessment work on claims.

NEW WAGE-SCALE AT BUTTE

When operations on a restricted scale are resumed in the mines of Butte on January 16, the wage-scale will be reduced 50c. per day from that prevailing during the past year. The following table shows comparative wages paid at different times:

	Miners	Laborers
1914	$3.50	$3.00
1918	5.75	5.25
1921	4.75	4.25
1922	4.25	3.75

At the start only four of the Anaconda company's mines will be opened but these will call for the employment of 6000 or 7000 men. The smaller mining companies in the district, to protect themselves against a labor shortage, have set forward their date for re-opening. During the suspension of copper production in Butte there has been a thinning of the ranks of mine workers, many going to Mid-Western industrial centres. Announcement is made that the Butte & Superior company plans resumption of production by about January 15, just as soon as the mill is in shape. Working forces will be increased gradually up to 1000. The North Butte, Davis Daly, and Tuolumne companies announce they will resume operations on January 16.

CHILE COPPER CO. PRODUCES METAL FOR 11.41 C. PER POUND—FAILS TO EARN BOND INTEREST

The statement recently issued by Chile Copper Co., covering operations for the third quarter of this year, showed a production of 12,023,000 lb. of copper at an operating cost of 11.41c. per pound and a deficit for the three months of $270,000, after interest but before depletion and depreciation had been charged. The three quarterly reports issued by the company this year indicate a production in the first nine months of 42,031,000 lb. of copper at a cost of 11.46c., and an operating deficit, after bond interest, of $1,023,000. Depletion and depreciation charges in this period increased the deficit to $3,206,000. In 1920, the company produced 111,000,000 lb. of copper at a cost of 10.7c. per pound and reported net profits of $2,056,000 before depletion charges. It is significant that costs in the current year have increased but slightly, while production has been cut in half. Chile's plans call for an increase in plant capacity from 15,000 tons to 35,000 tons per day as soon as conditions warrant. This should give the company a capacity for producing 300,000,000 lb. of copper per annum and on the basis of the 1920 cost of producing little more than one-third of this amount, it is estimated that Chile should then turn out its copper for 8c. per pound or lower.

Assuming a cost of 8c. per pound and a 15c. copper market, an annual production of 300,000,000 lb. would pay present bond interest requirements of $3,150,000 and $4.50 per share on the stock. Furthermore, present developed ore-reserves of 690,306,106 tons, the largest in the world, would be sufficient to maintain this output 365 days in the year for 54 years. There are 3,800,000 shares of stock outstanding, also $15,000,000 7% bonds, due March 1923, and $35,000,000 6% bonds, due April 1932. Both issues are convertible into stock, the 7s at $25 and the 6s at $35. Should all bonds be converted, there would be 5,400,000 shares of stock outstanding.

COPPER FROM THE CONGO

From out of the heart of the Congo there was shipped to Europe during 1921 approximately 70,000,000 lb. of copper, representing the output of the Tanganyika Concessions. The progress of Union Miniere—operating the copper properties of the Tanganyika Concessions—is indicated in the following tabulation of production, the figures being in pounds:

1911	1,994,000	1917	54,924,000
1912	4,984,000	1918	40,474,000
1913	14,816,000	1918	46,008,000
1914	21,444,000	1920	38,000,000
1915	28,108,000	1921	70,000,000
1916	44,298,000		
		Total	365,050,000

Robert Williams of London, who has been with the property since its inception, had a contract for a salary equal to 10% of any dividends distributed to stockholders; and in the event of his death 10% of surplus assets over liabilities. The directors have now made Williams managing director for life and given him 200,000 shares of stock in consideration for which he surrendered his earlier profit-sharing scheme. The arrangement provides that he shall retain at least one-quarter of the shares until his death.

THE FUTURE OF SILVER

At the recent annual meeting of the Mexican Corporation, Ltd., the following remarks were made by the chairman, F. W. Baker. "During the last year China has taken a large amount of silver and India has had a good monsoon, though the full benefit has not been felt owing to trading difficulties and the general trade depression. Trade depression and chaos on the Continent and the aftermath of war have no doubt lowered the demand for industrial purposes, and there has been no demand for renewal of coinage of some of the large Continental countries. These two last-mentioned factors should not be exaggerated in importance; it is the demand of India and China which plays the big rôle. Looking toward the next two years the big cloud in the sky appears to me to be the possibility of still further Continental liquidation on a large scale. Even if given reasonably good demand from the East, a quantity of silver may come into the market which cannot be absorbed. It is not known how long and to what extent this liquidation process will go on. It will no doubt be largely influenced by the political events of the next year. It is difficult to find out what the position will be. That is the dark side of the picture. On the other hand if the Continental outpouring dies down and Eastern demand is normal, with the help of the world's low production and the operation of the Pittman Act, we have a good chance of seeing prices higher than at present.

"It must be recognized that while the present price of silver appears high in comparison with the pre-war price, it is low by comparison with the difference between cost of production all over the world in the present and pre-war times. The New York price for five years pre-war was 55.8c., it is now 65c. There is a much greater difference in price in all the material required for the mining of silver. This factor of silver prices so far as Mexico is concerned may possibly be affected by a matter to which I would like to draw your attention, and which the Mexican government a short time ago had already under consideration, and upon which they had, as we are informed, consulted various mining authorities, but which unfortunately for us they dropped—namely, the question of subsidizing by a guaranteed minimum the price for Mexican silver, in behalf of the silver producers in that Republic. An enormous amount of capital has been and is being invested today in the development of mines in Mexico, with the result that the production of silver from the Republic represents one-third of the total silver production of the world, and will probably almost represent one-half for the current year. This silver is obtained either from silver mines or from mines where silver is associated with base metals or with gold, and because of this a great deal of money finds its way into the country. A large amount of labor is employed with very beneficial results to the Government and the population as a whole, and I venture to suggest it would be a wise step for the Mexican government in these times, when the fluctuations in the price of silver have a prejudicial effect on the development of their silver mining industry, to stabilize the price.

"The cost to the Government would be trifling compared with the direct and indirect advantages of maintaining this industry, and would keep in employment an appreciable portion of the population, particularly at a time when the country is going through a period of evolution resulting from the disturbed revolutionary period covered by the last ten years or more."

ARIZONA

Ajo.—A hoist has been moved from the Bisbee-Ajo mine to the C. P. Sheehan property, adjoining the old Gunsight. The 400-ft. shaft is to be deepened and lateral development is to be started on the 300-ft. level.——A company composed of Bisbee and Douglas mining men, known as the Ajo Mines Corporation, is developing the old Black Prince mine, 43 miles east of Ajo, a shaft having been sunk 150 ft. with an opening of a good lead-silver orebody and indications of copper. The company has a good mill-site and adequate water.

Douglas.—Though no official intimation is given as to the time for resumption of production, the Copper Queen smelter is being put in condition for operation. Percival G. Butler, for 15 years connected with the plant, has been promoted from assistant to general superintendent. He has placed a number of men at work on repairs, which include a new roof for the main smelter building.——The Golden Rule quarries, 40 miles from Douglas, have been leased by a San Francisco corporation, the Painted Desert Mining Co., represented by Ernest Lisherness. About $25,000 already has been spent in opening faces of what is declared the highest grade of building marble, the outcrop covered by 24 mining claims. About fifty men are to be employed.——J. H. Huntsman has sued in Pima county for judgment in the sum of $37,000 against the Dos Cabezas Gold Ridge Mining Co., of which he is president and W. A. Julian is secretary-treasurer. There is allegation of default in the payment of a number of notes made on behalf of the corporation.

Jerome.—At 600 ft., the main shaft of the Verde Central mine is bottomed in ore. This is at a point 200 ft. deeper than the drift where the apparent apex of an orebody was cut, and several hundred feet distant laterally. A station is being cut and lateral development will be started along the United Verde fault, in the direction of the ore already found. A large part of the operating company's stock is held by Calumet & Arizona interests, and was purchased at 70c. By the sale ample capital was secured for the development work planned by W. F. Staunton, the manager, who preferred to drift at depth, rather than to sink downward through the ore found in the upper drift.——A 47-ton carload of ore shipped by the Shea Copper Co. to El Paso has given a net return of $3412. The copper averaged nearly 5% and the silver nearly 100 oz. per ton.

Katherine.—In the Katherine Extension mine a new find has been made in the north cross-cut on the 250-ft. level. Development has not yet revealed the limits of the ore-shoot. ——A discovery in the Gold Chain mine demonstrates the downward continuation of the vein, opened several months ago on the 100-ft. level. The vein was opened for the second time in the shaft at a point about 35 ft. below the 100-ft. level. The ore is similar to that exposed east of the shaft on the 100-ft. level. It is proposed to continue sinking to a depth of 200 ft., where the vein will again be cross-cut and developed. With 200,000 tons of ore said to be in sight above the 100-ft. level, and the vein showing strong and well-defined in the shaft below, the outlook is encouraging.

Ray.—Plans for the reorganization of the Ray Hercules Copper Co. call for the formation of a new company to be known as the Ray Hercules Mines, Inc., with an authorized capital of 1,200,000 shares of stock having a par value of $5 each, together with $1,000,000 in first mortgage 6% bonds. Creditors of the present company and those directors who advanced the company money aggregating $2,287,562 to complete construction and development are to be given $1,000,000 in first mortgage 6% bonds and 250,000 shares of stock in the reorganized company. It is impossible to avoid wiping out the present stock of Ray Hercules, of which about 1,500,000 shares are outstanding, but the holders will be offered 750,000 shares of new stock of $5 par on cancellation and surrender of their present stock in the ratio of one new share for every two shares now held at $1 per share on or before January 31. In his report to the directors Robert Linton, president of Ray Hercules, estimates total ore indicated by churn-drilling and underground work, in ground wholly or partly developed, to be 3,916,000 tons averaging 2.42% copper. From this there has been mined 172,000 tons of ore averaging 2.20% copper, leaving the net available ore 3,744,000 dry tons averaging 2.43% copper.

CALIFORNIA

Kennett.—According to O. G. Egleston, local manager for the U. S. Smelting, Refining & Mining Co., further improvement in the price of copper will be necessary before his company can resume operations here. The cost of labor and of coke and other supplies has been reduced, but no definite date can be set for resumption.

Portola.—Work has been started at the Plumas-Chilcoot copper mine. A 30-ft. head-frame has been erected, and as soon as a compressor has been installed shaft sinking will be resumed from the 75-ft. level. Improvement in the outlook for marketing copper has encouraged the owners to resume operations.

Quincy.—Control of the old Valentine property near Mohawk has been acquired by George Stephan, of Quincy, and associates. The Valentine for many years was a profitable yielder of gold and silver, but has been idle for 30 years because of litigation. The owners plan to send a new shaft to a depth of several hundred feet and to conduct mining on a broad scale.

Walker Lake.—W. Harrison Whitacre, defendant in a suit instituted by Mary Means Gale, who charged that the company now operating a plant at Mono lake for the extraction of gold and other valuable minerals from the water of the lake, has been awarded a verdict by Judge Parker of the Superior Court. Mrs. Gale sued to recover $2000 that she had invested in the enterprise, on the ground that the undertaking was a fraud. According to reports, various assayers and chemists analyzed samples of the water and found gold content amounting to as much as $3.60 per ton. Whitacre claims to have perfected a process for recovering the gold. Judge Parker, apparently, was convinced that the defendant company was acting in good faith.

Map Showing Part of the Belgian Congo

Westport.—A 30-ton mill is running steadily at the Columbus mine, near Westport. The vein is 10 ft. wide. The working-tunnel has been driven 450 ft., with ore disclosures reported particularly good in newly opened ground. Water-wheels, receiving 30 miner's inches with a 1000-ft. drop, are used to operate the mill and compressor. The water is taken from the Volcano ditch and piped directly to the mine.

COLORADO

Aspen.—Towers for the Park tramway are rapidly nearing completion and the tramway will shortly be moving ore from the 100,000-ton reserve to the mill of the Silver Mines Company of America, that is now handling custom ores.——Good progress is reported made in the Hurricane tunnel by the Denver company headed by Archie Adams and associates. The main vein is not far distant and some rich ore is being mined from other veins cut as work advances.

The Richmond Hill M. M. & L. Co. is continuing operations through the winter and with the mill remodeled is reported making greater recovery.——High-grade ore is coming to the portal of the Hope tunnel, while the tunnel is being advanced in low-grade lead ore. The mine is now electrically equipped.——The Silver Mines Company of America is reported planning construction of a cyanide plant to handle ores not suitable for flotation. The company, under the management of J. T. Boyd, is using the Brown flotation process at its mill and is handling low-grade ore successfully.

Breckenridge.—Operations will be shortly resumed by the Wellington Mines Co. if suitable freight-rates can be secured. The mine is shut-down and in charge of watchmen, but if work is resumed, as is reported, about 30 additional men will be given employment.——The Royal Tiger Mines Co. continues operating with a reduced force.——The Tonopah Placer and the Blue River Placer dredges are still operating; the first named is close to the north boundary of the townsite and the Blue River dredge is two miles north.

Central City.—A report is in circulation that the Gregory and Bobtail mine of the Fifty Gold Mines Corporation, of Black Hawk, will be taken over by a company in course of formation, and that the several shafts will be drained and operated both on company account and under a liberal leasing system.——Another rumor is that the Gilpin Eureka mine and mill, closed on account of litigation, are shortly to resume. The mine has produced a good ore containing gold, silver, copper, and lead. The mill is equipped with 10 stamps.

Cripple Creek.—Including the December production of $425,000 the district is accredited with $5,288,334 for 1921, and a grand total of $411,057,340 to date.——Due to inactivity in the copper districts many old miners have returned, and it is estimated that 700 men have returned during the last few months. At the present time between 1300 and 1400 miners are on the payrolls, and lease operations are steadily increasing.

Durango.—The Durango smelter of the American Smelting & Refining Co. in 11 months of 1921, December not included, treated on an average 118 tons of San Juan basin ore, or a total of 39,048 dry tons, valued at $3,070,689, according to a report just issued by R. P. Reynolds, manager. Recoveries were as follows: gold, 50,466 oz., worth $1,039,317; silver, 1,762,316 oz., $1,745,494; lead, 9,348,824 lb., $238,878; and copper, 1,177,568 lb., $46,949. San Juan county mines shipped 1316 tons dry weight, worth $122,844; La Plata county, 1257 tons, worth $60,917; Dolores county, 365 tons, worth $14,170; Ouray county, 137 tons, worth $17,170; San Miguel county, 30,800 tons, worth $2,753,309; Mineral county, 1355 tons, $43,186; Lake county, 2128 tons, $20,811; and Eagle county, 1750 tons, $39,301.

Idaho Springs.—Samples of the shoot recently opened by the Frank J. Hayes Mining Co. indicate that the ore contains several ounces of gold and more than 100 oz. of silver per ton. The company is developing a group of four claims known as the Queen Elizabeth, Tomboy, Independence, and Lucky Lad. F. A. Brown is in charge of the work.

Leadville.—Mines of the Leadville district produced 14,669 oz. gold, 1,038,722 oz. silver, 3,936,063 lb. lead, 1,247,081 lb. copper, and 3,725,000 lb. zinc, valued at $1,965,707, during 1921, a decrease of 54.88%, or $2,388,760, as compared with the yield of 1920. Leadville has produced to date $491,667,188.

Rico.—The Robert Pellet sub-lease on the Emma mine at Dunton, owned by the A. E. Reynolds estate, has been purchased by H. M. Little of Denver and associates for a price reported to be "well into five figures". The property is under lease to the Dolores Silver Mines Co., from whom the Pellet lease was secured. A large tonnage of ore is reported blocked out and regular shipments will commence in the spring. In the meantime development will be continued under J. H. Litchfield, who has been retained as superintendent.

IDAHO

Coeur d'Alene.—Dividends for the year 1921 totaled $1,811,000. The heaviest producer and the best dividend-payer is the Bunker Hill & Sullivan Mining company, which has paid $981,000. Next to this comes the Federal Mining & Smelting Co., which has paid $590,000 on its preferred stock. The Hecla has paid $500,000. The Hercules is a close partnership and its dividends can only be estimated, but it is supposed to have paid $200,000 early in the year. The mine has been closed down for several months. One other Coeur d'Alene corporation, the Marsh, paid a dividend of $40,000 following the settlement of its litigation with the Hecla company.

The Marsh Mines Consolidated will begin at once operations to explore the famous Russell vein in its own ground. W. G. Harris, superintendent, will direct the work. Arrangements have been concluded with the Hecla Mining Co. to enable Harris to explore the Russell vein from the east workings of the Hecla at an elevation of about 260 ft. above the Hecla No. 3 tunnel and approximately 950 ft. below the Russell tunnel. It is proposed to follow the south branch of the Russell vein from the 30th floor, which exposes a well-defined fissure with some mineralization in the face. It will be necessary to drive about 400 ft. through intervening Hecla ground before reaching the Marsh.

Coleman & Ward, lessees of the Bluebird mine, owned by the Blacktail Mining Co., are working steadily and expect to ship 35 tons of high-grade ore by January 15.——The belief is that the Tamarack & Custer mine at least will resume operations by January 16. Several other properties may resume in the near future. From 30 to 40 work-horses are used by the Tamarck & Custer management when the plant is in operation to haul supplies up to the mine and mill.

MICHIGAN

Houghton.—Copper Range is now operating on a 60% basis, compared with the normal years of 1915 and 1916. Working forces are being gradually built up, particularly at Champion, which added about 75 men to its underground force in December. Champion production has been steadily increasing from month to month, the daily tonnage now being 2400, or approximately 62,000 tons per month. The yield here has fallen off only slightly and is now about 39 lb. per ton, refined. Baltic is hoisting around 16,000 tons of rock per month and Trimountain, 13,000. There is no change in yield in these mines and Trimountain is maintaining the improvement in quality of rock that has been in evidence for several months. Production, refined, is estimated at 2,700,000 lb. per month for the three mines. The amount of drifting being done is increasing each month at Champion and Baltic as more men are employed, and a full program of opening work likely will be under way at both of these mines in another month.

Arcadian Consolidated has reached a depth of 1050 ft. in its new sinking operations in the New Baltic shaft, which is being deepened from the 942-ft. level to a depth of about 1100 ft. to correspond with the 1050-ft. level of the New Arcadian shaft.

Calumet & Hecla shipped over 2,000,000 lb. of copper by rail in December. The smelter is now working on a big order for copper cakes, presumably for export to Germany. Over a million pounds of wire was shipped from the Dollar Bay wire-mill last month.

No. 2 Gratiot shaft of the Seneca will be one of the most modern shafts in the district. It will be of three compartments, with two skip-ways and a ladder-way. Work of preparing the shaft for resumption of sinking is progressing. The 'collar-house' is up and the steel work for the collar, which will extend down through the overburden, is completed and ready for the pouring of concrete. Work in the shaft below the collar is under way, but will be stopped temporarily while the concrete is setting. It will be necessary to clean out the shaft, widen it, and put in new timber before sinking can be resumed. For this work the old hoist will be of ample capacity. The new hoist equipment is at Mohawk, near Seneca, and will be delivered shortly to the site selected for it. The survey for the railway to the Gratiot shaft was recently completed. It is expected the shaft will be ready for sinking and the new hoist installed by spring. Meanwhile, opening work continues in the Seneca shaft, with encouraging results in all levels from the third to the seventh, inclusive. The third level, north, toward Gratiot No. 2, continues in the same good grade of rock which has characterized this opening from the start.

Mayflower reports an improvement in the north drift at the 1450-ft. level. This opening, however, is in but a short distance. All efforts will now be centred in this drift at this level, work in the south opening having been temporarily suspended. At the 1750-ft. level work is still proceeding in the cross-cut through the fault in the south drift.

MONTANA

Butte.—The Crystal Copper Co. during the first week in January shipped two cars of silver-gold ore from the Goldsmith mine that netted $2715 and $3689 respectively. Three other cars have been shipped but have not yet passed through the sampler at the smelter. A substantial tonnage of ore has been blocked out between the 500 and 700-ft. levels. The company is also shipping from the Crystal mine at Basin, the ore from which contains copper, silver, and gold. Ore has accumulated for many months and there is a good supply on hand to be shipped.

NEVADA

Royston.—Twenty-five thousand dollars worth of ore has been produced from the discovery shaft started about three months ago on the Betts lease on the Golden Eagle claim of the Hudson Mining Co. Numerous other rich discoveries of silver ore have aroused widespread interest in the district. Preparations for deep development of the district are being made by the Hudson Mining Co., which is controlled by the Walkers, of Salt Lake City, A. H. Jones of the same place, and W. H. Royston, and other mining men of Tonopah. The inclined shaft, which is now down 300 ft., is to be sunk to 600 ft.; it will play an important part in demonstrating the persistence of the orebodies with depth. The contract for this work has already been let.——Drifting has been started by the Super Six company, in which Los Angeles capital is interested, to prospect the orebody that has been followed by the shaft. This company is also sinking a vertical shaft near the Betts shaft, and is backing three sets of lessees who are driving a tunnel on the company's ground to tap two promising veins that have been opened on the surface.——M. L. Cooper of San Francisco and associates, who recently acquired control of a group of claims, are preparing to start development under the name of the Royston Piedmont Mining Co.——Over two feet of $50 ore has been opened on the Silver & Jones lease on the Aztec claim, and the ore has been exposed in trenches for a distance of 200 feet.

Tonopah.—During the first half of December Tonopah mills yielded approximately $300,000 in bullion and the total production of silver and gold for the month is expected to exceed $600,000. This includes some ore produced by mines at Goldfield, Royston, and Divide, but the great bulk of the treated product came from the Belmont, Tonopah, Tonopah Extension, and West End mines. The outlook for a record-breaking production period in 1922 is exceptionally bright, with recent work in the deep levels of all the principal properties highly encouraging.

Reduction Plant at the Braden Mine in Chile

Virginia City.—An option on the Middle Mines group has been taken by H. M. Ward, president of the Tonopah Extension Mines Co., operating at Tonopah. Developments are to start immediately under supervision of Alexander Wise. Ward states that the option was taken for Philadelphia and New York capitalists, and that the Tonopah Extension company is not interested. The Middle Mines group consists of several properties extending from the Consolidated Virginia mine to the South-End group near Gold Hill, and comprises 5000 ft. of the Comstock Lode. The properties composing the Middle Mines includes the Chollar, Best & Belcher, Hale & Norcross, Gould & Curry, Potosi, and other mines.

OREGON

Gold Hill.—At the Gold Ridge mine, where operations were commenced last summer, mill runs are averaging from $1500 to $1700 in gold per week. The plant is a modern 5-stamp amalgamating mill with a Wilfley concentrating table; the tailing is being stored for cyanide treatment. A new ore-shoot is being opened up at the south end of the stopes and a raise is being driven from the 500- to the 400-ft. level. The vein follows the top of a steep ridge, giving an opportunity to reach it with short cross-cut adits.

The Roaring Gimlet mine just below the Gold Ridge is being re-opened under lease by Mark Applegate and associates of Medford, Oregon. This mine is an old-time producer; it has been idle for nearly 20 years, and is considered richer than the Gold Ridge. The lessees have driven a new shaft on the vein to a depth of 100 ft. and are drifting at that depth under the old workings to open a new orebody.

The Millionaire mine two miles north of the Gold Ridge, which was re-opened two years ago by C. A. Knight and S. E. Heberline, has a crew of 20 miners employed. The mill is operated periodically. The old works are to be re-opened through the new 200-ft. shaft. About $100,000 has been spent on the mine in re-modeling the plant and in development. The mill has two 1500-lb. Nissen stamps with circular discharge and two 10-ft. amalgamating plates, with a crusher and a Standard concentrating table, all driven by electric power.

The Centennial placer diggings, a mile north-east of the Gold Ridge, has been re-equipped at an expense of $100,000 and after an idleness of 15 years. Production has commenced.

UTAH

Bingham.—No mining district in Utah was so adversely affected during 1921 as Bingham. At the close of the year local mining companies had a total of but 585 employees, the smallest number on the payrolls since the pioneer days of the camp. The United States Mining Co. continued to operate throughout the year, shipping its lead ore to the Midvale smelter of the company and its copper ore to the Garfield smelter. The company now employs 350 men; Utah Consolidated, 50; Utah-Apex, 20; Bingham Mines, 65; Utah Copper, 60; Utah-Boston (formerly the New England), 40. All men receiving more than $3 per day will be reduced 50c. per shift on January 16; those receiving less than $3 will be reduced 40c. per shift. The population of the camp has decreased from 8000 in 1918 to about 2500. It is believed the Utah Copper will resume operation on a limited scale about April 1, and the Utah Consolidated and Utah-Apex will probably resume shortly thereafter.

Eureka.—More than 70 lessees are now engaged at the Grand Central mine. Regular shipments to smelters were begun on December 29, by which time about 1000 tons of ore had been mined and was ready for shipment. The company has given a number of 'contract leases', by the terms of which the lessees are paid for footage made in drifts, raises, and winzes until ore of shipping grade is found. Thereafter the lessee pays for all materials and labor, and also pays the company a royalty. A large electrically-driven compressor has been received and is being installed.

Ore shipments for the week ended December 31 totaled 110 cars, as compared with 165 cars for the previous week, the decrease being due to the Christmas holidays. The Tintic Standard shipped 41 cars; Chief Consolidated, 28; Iron Blossom, 10; Victoria, 10; Eagle & Blue Bell, 6; Swansea, 4; Grand Central, 4; Dragon, 3; Colorado, 3; and Gemini, 1.

An exceptionally rich find has been made by lessees in the Iron Blossom mine. A shipment of 50 tons, averaging 750 oz. silver per ton, has been forwarded to a Salt Lake valley smelter. It is expected the net returns from this shipment will be approximately $35,000.

The output of ore from this district during 1921 was the largest on record; 8042 cars being shipped, as compared with 7397 carloads for 1920 and 6921 for 1919. The largest shipper was the Tintic Standard; its output was 2778 cars, as compared with 1508 in 1920 and 931 in 1919. The Chief Consolidated shipped 1880 cars of ore during 1921, as against 1948 in 1920. The general feeling among local mining men is that 1922 will be a more favorable year for the Tintic district than 1921. The re-opening of the Grand Central mine under a new leasing system; acquisition of additional territory by the Chief Consolidated Mining Co.; enlargement and improvement in the Tintic Standard mill at Goshen; increased activities of lessees, and the expectation of higher prices for lead and copper are the principal causes for optimism. More men are employed in the district today than at any time in its history. A wage cut of 50c. per day will become effective on January 16.

During 1921 the Tintic Milling Co. shipped about 50,000 oz. of silver-gold bullion to the Denver mint. Two cars of copper-silver bullion were shipped to an Eastern refinery, while four cars of lead-silver product was shipped to a Salt Lake valley smelter.

The Eagle & Blue Bell Mining Co. has had, for a number of years, a subsidiary company known as the American Star Mining Co., which it is proposed to consolidate with the parent company. Notices pertaining to the consolidation have been mailed to Eagle & Blue Bell stockholders. An important discovery has been made on the 2000-ft. level of the Eagle & Blue Bell, according to William Owens, superintendent. Ore has been cut for 30 ft. or more. This is the continuation of the immense deposit that has been worked on six of the lower levels.

Park City.—Ore shipments for the week ended December 31 totaled 1813 tons, as compared with 2602 tons for the preceding week; the decrease being due to the suspension of operations at all properties over the Christmas holidays. The Judge allied companies shipped 827 tons; Silver King Coalition, 616 tons; and Ontario, 325 tons.

During 1921, mines in this district shipped a total of 83,414 tons, as compared with 102,187 tons for the year 1920 and 79,299 tons for 1919. The principal reasons for the decrease in 1921 shipments were the low prices of lead and zinc, and the controversy between the American Smelting & Refining Co. and the Silver King Coalition and Daly-West companies, which resulted in the suspension of shipments for several weeks by the mining companies. Of the 1921 shipments, the Judge allied companies produced 37,666 tons; Silver King Coalition, 26,556 tons; Ontario, 18,092 tons; Naildriver, 1005 tons; and New Quincy, 95 tons.

WASHINGTON

Chewelah.—High-grade ore said to assay $200 per ton in silver has been found in the United Silver Copper company's mine, four miles north-east of here. The ore is on the 1400-ft. level, where a vein about 10 in. wide has been opened.

Spokane.—Reductions of freight-charges on products from smelters at Tacoma, Northport, Idaho, and Montana to Eastern points, approximating $2 per ton, and effective January 5, have been announced by officials of the Great Northern railway. The reduction affects especially lead derived from ores of the Coeur d'Alene and shipped from the smelters at Kellogg, Idaho, and Northport, Washington. While of most interest to lead miners, it applies also to spelter, and to copper, silver, and gold bullion. The reduction amounts to $\frac{1}{10}$ of a cent per pound. While not great in itself, it becomes important, according to mining men, when added to reductions in the cost of labor and materials.

WISCONSIN

Benton.—Several suits for damages have been brought in local and Federal courts by farmers against the Wisconsin Zinc Co. In the country courts of Lafayette county, Thos. Dawson was awarded damage from fumes from the separating plant amounting to $900 in settlement of claim brought for $3000. Wm. J. Curwen was given an award of $1000 in the Federal court, his claim being for $10,000. A petition was filed with the court praying for a permanent injunction to restrain the Wisconsin Zinc Co. from operating its magnetic separators at New Diggings.——A new zinc mine, on the former Sally Waters leasehold, has been developed. At 55 ft. a strong deposit of carbonate-zinc ore was opened; it was 30 ft. wide and about 4 ft. thick. At 110 ft. several 'blankets' of sphalerite were opened.

Cuba City.—The Zinc Hill Mining Co., operating the Big Dick mine, resumed active mining operations after a shutdown lasting nearly a year; 25 men were put to work. In order that marketing may be accelerated the company purchased the magnetic-separating plant, the property of the Linden Zinc Co. It was planned to enlarge and improve this plant.——The Connecting Link Mining Co. sold 1200 tons of low-grade zinc concentrate and 1000 tons of pyrite to the National Separators and a fleet of automobile trucks was kept in action all month making delivery.

Platteville.—A decided turn for the better in the zinc-mining industry is noted in the month of December; operators express more confidence than for some time. Some mines, long idle, resumed active operation; better offerings for all grades of zinc ore stimulated selling, and all over the field could be found new organizations engaged in prospecting.

A substantial advance in the price of high-grade blende in the Joplin district was reflected in the current offerings in the Wisconsin field; $30 per ton, base price, for 60% zinc had prevailed, but when this figure became established in the Mo-Kans-Okla districts the price in Wisconsin jumped to $33 per ton. The separating plants in operation came into the market promptly for more milled zinc concentrate; one company sold 1200 tons of low-grade zinc concentrate, and 1000 tons of pyritic concentrate to the National Separators at Cuba City. Another company marketed 500 tons of low-grade zinc ore, and production was increased at mines providing low-grade zinc ore used largely as base for the manufacture of sulphuric acid.

The price of lead ore was well maintained through December, and the demand was good. Producers, however, were reluctant sellers, believing the price would go higher, and there was little marketing. Many out of employment, backed by local business interests, and encouraged in the belief that lead-ore prices will remain relatively permanent, sought leaseholds and began prospecting.

There was held in reserve at the close of the year over 10,000 tons of high-grade separator blende. Nearly all of this was in the hands of electro-magnetic separating plants. There was also in reserve at mines, over 15,000 tons of zinc concentrate of all grades. A conservative estimate places the lead ore held at about 3000 tons; of pyritic ore about 25,000 tons.

The Zinc Roofing & Products Co. reported a fair business for zinc shingles and corrugated zinc, for building purposes in the Southern States. Extensive preparations were made for an enlarged business in the products of this concern over the year 1922. The building of a new 200-ton zinc-mill for the Block-House Mining Co. was continued and the installation of heavy machinery will prepare the plant for service early this coming spring.

BRITISH COLUMBIA

Ainsworth.—The Florence Silver Mining Co., which recently has been shipping the whole of its output to the Bunker Hill & Sullivan smelter, has been making negotiations for the sale of part of its output to paint manufacturing companies on the Coast. The Florence mill produces high-grade lead and zinc concentrates, both of which are low in silver.

Alice Arm.—D. Jeremierson has let a contract for the hauling of 100 tons of ore from the Esperanza mine, which is situated one mile north of here, to the wharf, whence it will be shipped to Anyox. This shipment is an experiment, and, if it is found profitable, shipping will be continued. Salina Brothers, the previous owners of the mine, made several small shipments when metal prices were higher.

Nelson.—O. C. Thompson and associates, lessees, have done repair work at the Utica and are driving the long tunnel that is expected to cut the main orebody at any time. Several good bodies of ore have been found in the old workings, so, from now on, the mine will be making regular shipments to Trail.——J. W. Mullholland has started a crew at work on the Iva Fern mine; he will superintend the operations himself.

Penticton.—C. Stevenson and Martin Ravey have made a reconnaissance of the Whipsaw district for a Vancouver syndicate, and it has been decided that a careful survey of the districts by competent geologists is to be made next spring, with a view to developing a new goldfield. This work has been started because the late George Dawson described it as a likely district.

Quesnel.—The Provincial government, at the request and at the expense of the owners of the claim, has started drilling operations on the Lafontaine claim, with a view to rediscovering the lost channel. J. D. Galloway, resident mining engineer for the district, has planned the work which will be carried out by C. W. Moore, of Barkerville.

Victoria.—Owing to returns made by the Premier Gold Mining Co. at the very close of the year, which it was anticipated would not have been made in time to be included in last year's production, the mineral production of the Province will be considerably greater than was expected when the official estimate was made; it will reach $28,934,848. The Premier, which has produced more than a million ounces of silver and more than 25,000 oz. of gold; will cause both the gold and silver productions to be greater than those of 1920. The zinc and lead output from the Sullivan mine are in excess of what previously was anticipated, so that the value of the total mineral output will fall only about 15% short of that of 1920.

MEXICO

Chihuahua.—H. C. Meili and Francisco Chavez, operating extensively in the Parral district, have recently re-located La Boquilla and San Alberto mines in the Cordero district. The San Alberto is to be re-titled under the same name, while the Boquilla is hereafter to be known as the Libertad. Adjoining these properties are the Chicago, El Toro, San Pedro, and La Parcionera mines.——Mrs. Adelina de Palma has taken up the Joyce, a group of four silver-lead properties in the Huerfano mountains, district of Jimenez, in the southern part of the State.——Rosario H. Perez, of Agua Caliente, is developing some new claims in the municipality of Ocampo. He has also re-denounced the Juanita and La Esmeralda mines which were allowed to lapse through non-payment of taxes by the former owners.——Salome Escandon has re-located the Guillermina mine in the Ocampo district; it is to be re-titled as the San Miguel. It is composed of six pertenencias bearing gold and silver ores.——The mining agent at Ciudad Guerrero, in the western part of the State, has recorded the Esperanza group of twelve claims in the name of Emilio Portillo and Rufino Armenta, of Madera. The new claims are situated near the San Andres mines.

Jose Fernandez and Ursulo Garza, of Chihuahua City, have applied for titles to their Mariposa group of silver-lead mines in the Santa Eulalia district. Development work is disclosing some good ore in the main vein of this property.——Angel F. Campos, commission merchant of Palo Armarillo, has applied for titles to the Placer de Tojiachic group on which he has discovered some good ores of gold, silver, and lead.——The San Vicente group, comprising five adjoining claims, in the famous Batopilas mining region, has been located by Vicente Real. The property is near the old Dos Cantones mine which was formerly owned by Yee San and Wong Chong.

Nacozari.—A shipment of four carloads of ore and concentrate is being made from the Las Chispas mine of Minas Pedrazzini Gold & Silver Co. One car of high-grade will net over $100,000 and the whole shipment will produce about $160,000.——The work on the concentrator of the Moctezuma Copper Co. is going ahead at top speed. A number of men have been transferred here from the work on the Bisbee concentrator, and other mechanics and carpenters are coming in on every train.

Torreon.—The Cia. Minera de Peñoles has blown in two furnaces of its Torreon plant and is employing several hundred men. A number of mines in this vicinity have resumed operations and are now shipping. The plant here has eight lead and one copper furnaces, the capacity of which has been increased during the past few months.

ONTARIO

Cobalt.—The annual report of the Coniagas for the year ended October 31 shows an output of 1,301,815 oz. of silver, as compared with 994,235 oz. in 1920. The profits were $422,238. Total assets stand at $6,267,955 as against $6,734,972. The tonnage of ore milled was 113,279 tons. Operating costs were 33.52c. per ton, as compared with 48.99c. for the previous year.

The La Rose is extracting from the 90-ft. level of the University the richest ore yet found on the property. On the 530-ft. level of the Violet 225 ft. of good ore has been opened. The company has enjoyed the most productive year of the last five, an advance estimate of profits being in the neighborhood of $150,000.

Ore of a good grade has been cut in drifting on the 60-ft. level under Giroux lake, on the A 53 property in the Gillies Limit. The shoot is 40 ft. long.

Kirkland Lake.—During November the Lake Shore produced $54,343 from the treatment of 1810 tons of ore, being an average recovery of $30.02 per ton. The mill ran 92.36% of the possible running time. Some of the ore extracted from development work at the 600-ft. level contained upward of $100 per ton.——A report issued to the shareholders of the Queen Lebel states that some 4000 ft. of trenching has been done and six veins opened. No. 5 vein has a width of 5 ft. and yields the best assays, running from $1 up to $33 in gold and 37½ oz. silver. It has been stripped for about 400 ft. with a test pit 10 ft. deep.

Two big veins carrying high-grade ore have been opened by the Tough-Oakes at a point within 200 ft. of the western boundary. The deposits lie along the main break, which enters the Tough-Oakes from the Sylvanite, and is regarded as of much importance to the latter property, as the main break across it is approximately 1500 ft. in length.

At the Bidgood the vein has been cut at the 400-ft. level, where the mineralization extends across a width of over 20 ft., but the gold content is not so high as on the 300-ft. level.

Porcupine.—The contemplated reduction of miners' wages has gone into effect. The Hollinger Consolidated has announced a reduction of 6c. per hour, or 48c. per day, effective on January 1. Other mining companies are making a similar cut. This is the first reduction made since the close of the War and will bring the rate down nearly to the level of the Cobalt silver mines.——The Dome Mines treated about 30,000 tons of ore in November. The mill-heads averaged $8.40 per ton and the operating costs were about $3.50 per ton.——The shareholders of the Porcupine Vipond-North Thompson on December 28 approved the sale of the unissued portion of the Treasury stock for 15c. per share. ——Out of six holes drilled by the Nipissing on the Rochester property, five showed encouraging gold content. One hole showed a section of 5 ft. that assayed $88 per ton.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Louis S. Cates is at Los Angeles.

W. J. Elmendorf of Seattle is here.

W. W. Mein is on his way back to New York.

Edward Thornton recently made a trip to Nacozari.

Scott Lintner has left San Francisco for Topia, Mexico.

H. T. Darlington is at the Brown Palace Hotel, Denver.

A. Harms, of Rock Island, Illinois, is now at Durango, Colorado.

W. O. Pray, recently at De Beque, Colorado, is at Stockton, California.

T. W. Mather, who has been at Pacific Grove, California, is in New York.

Joseph Irving was at Tombstone, Arizona, last week. He is now at Jerome.

Mortimer L. Hall has moved from Pasadena, California, to Gold Hill, Nevada.

A. B. Frenzel, formerly at Denver, is now residing at Pasadena, California.

Waldemar M. Ervin has moved from Hesperia, California, to Socorro, New Mexico.

A. L. J. Queneau is managing director for the Var Oil & Coal Co. at Boson, in France.

J. Mackintosh Bell, consulting engineer to the Keeley Silver Mines, Ltd., is in London.

H. Foster Bain, Director of the U. S. Bureau of Mines, was in San Francisco early in the week.

F. G. Jackson is now on the staff of the Bureau of Mines Experiment Station at Columbus, Ohio.

William Loeb, Jr., of the New York office of the American Smelting & Refining Co., is at Salt Lake City.

G. A. Joslin, managing engineer for the Ramshorn Mines Co., is now at the head offices at Salt Lake City.

S. F. Shaw has completed examination of the properties in Mexico belonging to the Cia. Metalurgica Mexicana.

Paul Billingsley, of the International Smelting Co. at Salt Lake City, has been inspecting mining properties in central Idaho.

William J. Cox has retired as manager for the Camp Bird company, and as advisory engineer to the Santa Gertrudis company.

J. Walter Foote, mining engineer for the Nevada Consolidated Copper Co., at Ruth, Nevada, has been spending the holidays at Salt Lake City.

William T. MacDonald, of Salt Lake City, has become mill superintendent for the Moctezuma Copper Co. at Nacozari, Mexico. He was at Los Angeles last week.

Hugh M. Henton, formerly instructor in metallurgy at the Case School of Applied Science, has entered private practice as a consulting mining and metallurgical engineer, with headquarters at the National City building, Columbus, Ohio.

P. H. Pernot spent the greater part of December in making examinations in the neighborhood of the Las Chispas mine in the Arizpe district, and is now looking over the various properties of the Sonora Development Co., in the Moctezuma district.

John Dern, a pioneer mining man of Utah and Nevada, died at his home in Salt Lake City on January 2. He was 71 years of age and a native of Germany. Last June he went to Europe to visit his old home, and returned in November. Shortly thereafter he was stricken with heart trouble, which was the cause of his death. He was one of the organizers of the Consolidated Mercur Gold Mines Co., and later became interested in the Tintic district and in several Nevada mining properties. He is survived by a son and a daughter.

METAL PRICES

San Francisco, January 10

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6.25— 8.25
Copper, electrolytic, cents per pound	14.75—15.25
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$93
Platinum, 10% iridium, per ounce	$104
Zinc, slab, cents per pound	6.75— 7.75
Zinc-dust, cents per pound	9.50—10.00

EASTERN METAL MARKET

(By wire from New York)

January 9.—Copper is quiet and easier. Lead is inactive and steady. Zinc is dull and easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Jan.	3	64.12½	34.50	Nov.	28	67.55	37.85
"	4	65.00	34.87½	Dec.	5	67.27	37.35
"	5	64.25	34.50	"	12	65.46	35.44
"	6	64.87½	34.87½	"	19	66.08	35.60
"	7	64.87½	34.75	"	26	65.50	35.25
"	8 Sunday			Jan.	2	64.82	34.90
"	9	66.25	35.50	"	9	64.90	34.83

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	[illegible]
June	110.50	[illegible]	58.51	Dec.	131.92	64.78	65.76

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Jan.	3	13.62½	Nov.	28	13.35
"	4	13.62½	Dec.	5	13.39
"	5	13.62½	"	12	13.46
"	6	13.50	"	19	13.58
"	7	13.50	"	26	13.62
"	8 Sunday		Jan.	2	13.62
"	9	13.50	"	9	13.56

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	13.54

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Jan.	3	4.70	Nov.	28	4.70
"	4	4.70	Dec.	5	4.70
"	5	4.70	"	12	4.70
"	6	4.70	"	19	4.70
"	7	4.70	"	26	4.70
"	8 Sunday		Jan.	2	4.70
"	9	4.70	"	9	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	4.70

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	32.49

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Jan.	3	5.17½	Nov.	28	5.14
"	4	5.17½	Dec.	5	5.23
"	5	5.17½	"	12	5.31
"	6	5.15	"	19	5.19
"	7	5.15	"	26	5.23
"	8 Sunday		Jan.	2	5.17
"	9	5.15	"	9	5.16

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4 41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5 09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	5.24

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Dec.	13	52.00	Dec.	27	48.00
"	20	52.00	Jan.	3	50.00
			"	10	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	40.40
June	94.40	85.00	49.50	Dec.	95.00	52.50	49.50

R. L. AGASSIZ DISCUSSES COPPER

R. L. Agassiz, president of the Calumet & Hecla Mining Co., in an article in the New York 'Tribune' of January 1, 1922, said in part: "The copper industry is not a charitable institution. Neither is it a mendicant. Having plenty of copper in a refined state for any domestic or foreign demand that was likely to materialize, it closed most of the mines, and today only a few properties actually are operating. How soon the mines will open again is a question I shall not attempt to answer. It is a matter that must be carefully studied, keeping in mind the thought that if a re-opening of the vast producing properties anticipates a demand, which later fails to manifest itself, the industry is in danger of again creating the very condition that it has been wrestling with for the last three years.

"This condition has been referred to from time to time as one of over-production. Actually it is a condition of under-consumption, in part brought about in this country by the substitution of cheaper metals and materials during the war period, when copper, brass, and bronze were not to be had for commercial purposes, and in Europe by a lack of funds wherewith to buy our metals. Domestically the situation is steadily improving. Slowly but surely copper, brass, bronze, and copper products generally are coming back into their own. Europe will buy when Europe has money. Meanwhile, as is well known, the copper-producing interests, through the agency of the Copper Export Association, have done all that they could to help out the stricken nations across the water with the raw materials to start some of their industries moving.

"In building enterprises copper and brass have a place that cannot profitably be taken by substitutes, just as other metals and materials have places in common-sense construction work that copper and its products would not be expected to fill. This is gradually coming to be understood by those who put their money into building enterprises, and it is one of many encouraging developments of the last eighteen months. The orgy of cheap substitution seems to be disappearing, and not only in building but in other forms of investment our people are realizing that there is no real economy in short-lived materials which require constant upkeep and replacement charges, no matter how attractive and tempting the slightly lower initial cost may be. The electrical industry is regarded today by experts as being in its infancy, however marvelous the developments of the last two decades may seem to most of us. Copper has run side by side with American inventive genius in bringing this great industry where it is at present.

"The two are inseparable, and we may expect a continued large absorption of copper as present electrical enterprises expand and new ventures in this field are started. Not only in this country but in South America and Europe we hear with great frequency nowadays of new projects having electrical power for their base being undertaken. Within a month announcement was made that the telephone interests of the United States would spend $80,000,000 during the coming year for additional equipment, a large part of which necessarily will be copper. Chile, a few weeks ago, placed a $7,000,000 order in this country for materials to be used in the electrification of her railways, and Japan, which has 6000 miles of government-controlled railways, began a program of electrification by placing a $5,000,000 order here."

MONEY AND EXCHANGE

Foreign quotations on January 10 are as follows:

Sterling, dollars:	Cable	4.23½
	Demand	4.24
Franc, cents:	Cable	8.42
	Demand	8.44
Lira, cents:	Demand	4.38
Mark, cent:		0.62

Eastern Metal Market

New York, January 4.

The year commences with the tone of all the markets good; there is optimism as to future activity. Prices are firm to strong.

The copper market is temporarily inactive, but prices are firm to strong. Moderate activity characterized the closing days of the old year with prices firm.

The lead market is steady and fairly active with no change in prices.

Demand for zinc is very light, but changes in quotations are slight.

Antimony remains lifeless and stationary.

IRON AND STEEL

The steel trade enters upon the new year in a spirit of hopefulness, says 'The Iron Age'. It expects 1922 to be better than 1921. The fact is emphasized that the country has been swept bare of steel and that consumers, having used considerably more material in 1921 than the mills shipped them, now have the mills as their sole dependence. While capacity will continue well in excess of demand, a 60% scale of operation at some time in the new year is not considered too much to expect.

The year 1921 goes down in the records as a 38% year in steel. Ingot production probably exceeded 19¾ million tons, against 40,881,000 tons in 1920. The immediate future of demand and prices is not clear.

Holiday banking of blast-furnaces amounted to much less than was looked for. Production in December was 1,649,086 tons, or 53,196 tons per day, as compared with 1,415,481 tons in November, or 47,183 tons per day. The daily increase was about 6000 tons, or 13%. Six furnaces blew-in last month and one blew-out, the number active on January 1 being 125, against 120 one month previous.

COPPER

The last week or two of the old year has been quiet both as to buying and inquiry for copper. The price has maintained its stability, however, and quotations for electrolytic copper are quite firm at 13.62½c., New York or refinery, and 13.87½c., delivered, for early or January delivery. For first quarter the minimum is probably 13.75c., New York, or 14c. delivered. A few large producers are asking more. Rumors that 13.87½c., delivered, could be or had been shaded ⅛c. were not confirmable yesterday and it is doubtful if this is true. At any event, the amount thus available was probably small. Optimism rules as to the future. Prospects are excellent for good domestic demand and continued excellent foreign buying. Mining operations in some quarters are to be resumed as rapidly as the necessarily slow process can be accomplished.

TIN

The last week of the year was a moderately active one. While very little business was done in future-shipment Straits tin, there were fairly good sales of early-arrival metal and spot-delivery shipment, although even this total was small. The London market yesterday was £2 per ton under quotations a week ago at £168 12s. 6d. for spot standard, at £170 10s. for future standard, at £170 per ton for spot Straits. Deliveries into consumption in December are returned as 3710 tons, of which only 110 tons is credited to Pacific ports. Metal in stock on December 31 was 516 tons with 1180 tons landing, a total of 1696 tons. Imports for the year 1921 are reported as 24,758 tons or less than 50% of the 1920 imports of 50,563. Of the 1921 imports, 20,319 tons came from the Straits Settlements.

LEAD

The last two or three days of the old year were featured by brisk sales by a few producers on a basis of 4.40c., St. Louis. A firmer market at St. Louis is the result and is the only change, the New York price of the independents and the leading interest remaining at 4.70c., which has been the quotation of the latter since some time in September 1921. The London market continues strong.

ZINC

Demand has been and is light as the new year opens. There is not a broad market in sheets as yet and this affects the spelter market. However, there is some buying, mostly of carload lots, which has been done at 4.82½ and 4.85c., St. Louis, depending on the seller. The market for early delivery is quoted at 4.82½c., St. Louis, or 5.12½c., New York, for January, with five points advance over the 4.85c. level both of February and of March. While but little new business is in sight, the tone of the market is by no means pessimistic, for the stocks in consumers' hands are not large. Price liquidation was complete in 1921. With the high for the year at 6.10c., New York, in January and with the low at 4.62½c., New York, in August, the closing price of 5.12½c. compares with 5.76c. and 5.27c. in 1913 and 1914, respectively.

ANTIMONY

Quotations for wholesale lots for early delivery are unchanged at 4.50c., New York, duty paid, with little buying reported.

ALUMINUM

The leading producer quotes wholesale lots of 15 tons at 19.10c. per pound, f.o.b. plant, which is 10 points higher than quotations in 50-ton lots. The same grade, or imported metal, 98 to 99% pure, is quoted by importers at 17 to 18c., New York, duty paid.

ORES

Tungsten: There are no features or developments and quotations remain nominal at $2 per unit and higher, depending on the grade, etc.

Molybdenum: Nominal quotations prevail of 45 to 50c. per pound of MoS_2 in regular concentrates containing 85% MoS_2.

Manganese: There is absolutely no interest in the market and prices are nominal at 20c. per unit, c.i.f. Atlantic ports. Imports in November were only 8620 tons, bringing the total to December 1 to 386,454 tons as compared with 542,189 tons to December 1, 1920.

Chrome: No demand from consumers is reported and nominal quotations prevail of $20 to $28 per net ton, c.i.f. Atlantic ports.

FERRO-ALLOYS

Ferro-manganese: Sales are confined to carload lots at prevailing quotations of $58.35 per ton, seaboard, for both British and American alloy, except that of the Steel Corporation which sells at $60, Pittsburgh, when in the market. Imports to November were only 270 tons, making the total 8818 tons to December 1 against 53,830 tons to December 1, 1920.

Spiegeleisen: An inquiry for 150 tons is the only development except sales of carload lots at $26, furnace, for the 20% alloy.

Ferro-tungsten: Business is flat at nominal quotations of 40 to 45c. per pound of contained tungsten in the domestic alloy, with the foreign quoted at 50c., seaboard.

Ferro-silicon: The 50% alloy market is quiet with quotations unchanged at $55 to $57 per ton, delivered.

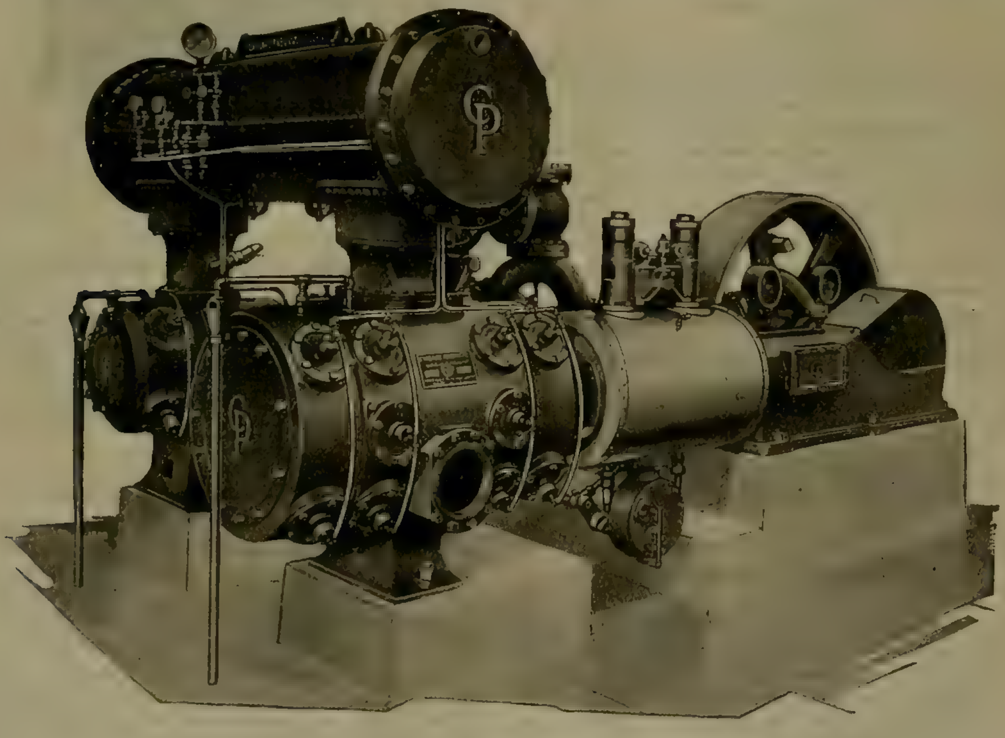
Ferro-chromium: No change is recorded in a dull market. Quotations are 11 to 14c. per pound, delivered, depending on the grade, quantity, and composition.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

NEW TYPE OF STEAM-DRIVEN AIR-COMPRESSOR

During late years the builders of steam-driven air-compressors have made little effort to improve the steam-economy of their machines. The development of the steam-driven air-compressor has not kept pace with the development of the steam-engine—today the steam-consumption per unit of work of the former is much higher than that of the most modern steam-engine built for general service. There has been an urgent need for improvement in compressor design and this need has been greatly increased by th widespread and ever-growing use of superheated high-pressure steam.



Chicago Pneumatic Tool Co.'s Dual-Flow Steam-Driven Air-Compressor

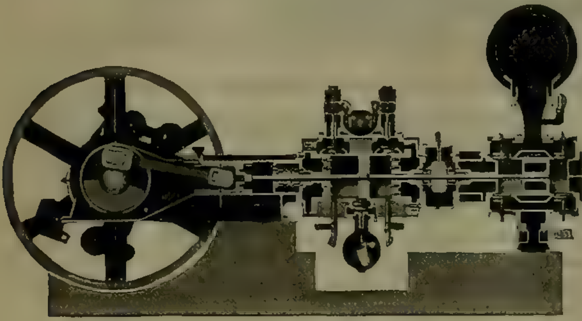
The Chicago Pneumatic Tool Co. has taken an initial step in meeting present-day demands, and is now producing a steam-driven air-compressor in which far better steam-economy is obtainable than has heretofore been found possible and which meets, as does no other, the conditions imposed by superheated high-pressure steam.

The steam-end of the 'dual-flow steam-driven air-compressor', as the new machine is called, is entirely new and distinctive—yet it is not an experimental innovation. The design is based upon principles which have already proved their soundness and superiority in steam-engine practice.

The foremost feature is the steam-cylinder, which is so designed and constructed that initial condensation is almost entirely eliminated, resulting in a great saving in steam. Initial condensation is one of the greatest preventable losses in steam-engines of the old counterflow or compound types; it is caused by the cooling of the cylinder-walls and cylinder-head by the comparatively cool exhaust steam as it washes over them in leaving the cylinder through the same port by which it entered.

In the dual-flow cylinder, the exhaust steam does not wash back over the walls and head, but leaves through a port in the centre of the cylinder. Thus the interior surfaces of the cylinder remain at nearly the same temperature as the entering steam, and initial condensation is reduced to the absolute minimum. The exhaust port is uncovered by the piston when the latter has traveled about half its stroke. The exhaust is controlled, however, by a patented steam-tight poppet valve, which opens when the piston is near the end of its stroke and closes again (if the machine is running non-condensing) when the piston covers the port on the return stroke. When running condensing, the valve closes early in the return stroke.

The dual-flow cylinder has several advantages over uniflow types. In the first place, it enables a material saving in steam-consumption when running non-condensing. Since the piston of a uniflow engine covers the exhaust-port at the start of the return-stroke, some provision must be made for preventing excessive compression. This usually takes the form of large clearing spaces. If there is any back-pressure, there must be still greater clearance. Compression in the dual-flow cylinder, on the other hand, does not begin until the piston has traveled half the return stroke. The result can be plainly seen by referring to Fig. 1, in which the diagram of a dual-flow cylinder is superimposed upon that of a large-clearance uniflow machine.

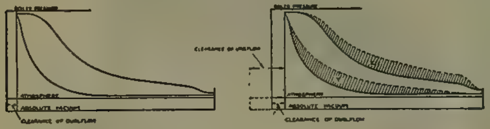

Sectional View of Compressor

The area 'A' is lost by the uniflow machine, owing to early compression; it must be offset by the area 'Z', which means the addition of more steam, later cut-off, higher release, and less expansion.

Secondly, the dual-flow design permits of shorter cylinder and much shorter piston, hence the weight of the reciprocating parts is considerably less.

Thirdly, there is less friction and the cylinder can be more easily lubricated.

Valve-leakage probably causes a greater steam loss than any other single factor. Especially is this true of installations where superheated high-pressure steam is used; in fact the faults common in most of the valves now used, such as leakage, excessive clearance, necessity of valve lubrication, etc., have served to defeat the advantage to be derived from the use of superheated steam.



(A) (B)

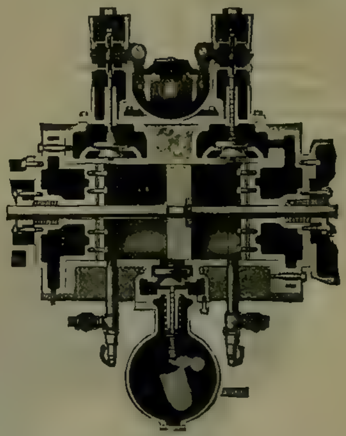
Fig. 1. Steam-Diagrams

The valve problem has been solved in the case of the dual-flow steam-driven air-compressor by the adoption of the Skinner steam-tight double-seat poppet-valve (patented) for both admission and exhaust. This valve will remain steam-tight indefinitely and will seat perfectly, regardless of the pressure or temperature under which the cylinder is operated. It has been known to keep steam-tight with one grinding, with 159 lb. pressure and 150°F. superheat and also with saturated steam at 100-lb. pressure. No lubrication is required.

Inequalities of expansion of the metals forming the valve and seat, due to different co-efficients of expansion, are entirely compensated for; and there is no side-thrust imposed upon the stem by the lifting mechanism.

The governor is mounted in the flywheel and operates by centrifugal force and inertia. The governor-arm is connected to the steam-valve eccentric, and by changing the throw of the latter it changes the point of the cut-off of the steam entering the cylinder. This method is far superior to the old scheme of merely throttling the steam. Variations in speed may be made by adding or removing weights.

Unlike the old counterflow engines, which were regulated economically by slowing down during the unloaded periods of the compressor, the dual-flow is a constant-speed machine, and shows the best steam-economy when operating at its greatest speed. Regulation is therefore effected by two-step capacity control: two differential unloaders connect with the inlet-valves, and reduce the capacity of the compressor in two steps. One unloader holds open the inlet-valves on the crank-end of one cylinder and the head-end of the other; the second unloader holds open the inlet-valves at the opposite ends. This is one of the simplest, most positive, and most efficient methods of regulation known.


Sectional View of the Steam-Cylinder

The air-valves are of the well-known Simplate independent-disc type.

COMMERCIAL PARAGRAPHS

Industrial Works, of Bay City, Michigan, is distributing catalogue No. 113, illustrating and describing the Type BC 'Industrial' crawling-tractor crane of 20,000 lb. capacity. This crane is adapted to the needs of road contractors, lumber and coal dealers, gravel, sand, and stone producers, foundries, and other moderate-size industrial plants.

It is generally conceded that the year now opening will bring in its course the beginning of the long-heralded boom in electric-light and power-plant construction. As an indication of this approaching activity, **Dwight P. Robinson & Co.**, engineers and constructors of New York and Chicago, have secured important contracts from the Duquesne Light Co. of Pittsburgh and the New Orleans Railway & Light Co. The work for the Duquesne Light Co. includes the installation of the second unit of 60,000 kw. at the Colfax Power Station, together with three additional substations along the company's lines in the Pittsburgh district. The Colfax station is designed ultimately to be one of the largest steam stations in the country, containing six 60,000-kw. units. The first unit was put in operation last year and the installation of the second unit now authorized is a part of the company's plan to provide additional facilities as the demand for power increases. The New Orleans Railway & Light Co. is proceeding with extensive additions to its power-plant and distributing systems, including the installation of a 20,000-kw. turbine and auxiliaries.

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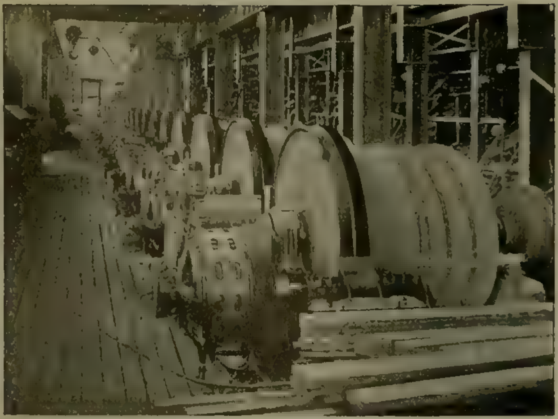


BRADEN—
Marcy Ball-Mill Installation

COPPER QUEEN—
Marcy Roller-Mill Installation

T. A. RICKARD, ... Editor

RESUMPTION of mining operations is announced from the Lake Superior copper region. The Calumet & Hecla, Ahmeek, Allouez, and Isle Royale will start again on April 1. Men will be put to work from time to time before that date to repair the plants and restore the equipment. It is not expected that production will be more than half the normal at first, but it will be increased as rapidly as the market for copper improves.

AN important though perhaps selfish reason for the cementing of the ties between the great English-speaking peoples may be found in the statistics recently issued by the Department of Commerce, and reproduced in our news columns, on the export trade of the United States with the remainder of the world. Great Britain was our best customer during 1921, buying goods to the value of about $940,000,000; our sales to Canada during the same period were the next highest and totaled about $600,000,000. Volume of business, by and large, may be taken as an indication of goodwill and an evidence of international amity.

THAT arbitrary restrictions limiting individual efficiency have had a pernicious effect on industrial progress is the opinion of Mr. George H. Bruns, who discusses the question of wages in a recent issue of the 'Annalist'. Limitation rules promulgated by labor-unions tend to destroy all pride of performance on the part of the worker. Increase of output is essential if high wages are to be maintained. On the other hand, a rate of pay that is disproportionate to the cost of living has been shown to result in poor physique, as well as low standards and ideals of living; it leads to limited education and lessened efficiency as a result of diminished vitality, causing slack work and restrained production. If a high standard of output be attained by Labor, there need be no fear as to the rate of wages that Capital can afford to pay.

QUITE as essential as the knowledge of the purposes for which an instrument is useful, is the appreciation of its limitations. Judging from the character of the questions asked in sundry letters we have received recently, the article in this issue on 'Magnetic Prospecting' should serve a double purpose, for there appears to be some misapprehension as to the applicability of the various instruments, in which the magnetic needle is the essential element, for ascertaining the existence and position of orebodies. Mr. Walter S. Weeks, Associate Professor of Mining in the University of California, is known to our readers by the valuable series of articles on mine-ventilation that we published about a year ago. As might be expected, Mr. Weeks goes to the root of the problem, explaining in plain terms the theory of the various instruments and the methods of using them. He advises the non-technical prospector not to attempt to use any of the instruments except the dip-compass. We invite engineers who have been successful in using the magnetometer, or any kindred device, to send us detailed data regarding their methods and the results obtained. These will supplement the excellent article we now publish.

GREEN spectacles and orange spectacles make the same thing look different. We are reminded of this truism by a letter received from a metallurgical engineer residing at Wallace, Idaho. He calls attention to an "error" appearing in a recent article in which was described an ingenious method of welding, at the Bunker Hill smelter, sundry broken cast-iron pots by the oxy-acetylene process. The article in question appeared under 'Industrial Progress' and was written by an engineer for the firm that devised the scheme for successfully making the weld. He stated that the repair was made on an 8-ton pot, that being the approximate weight of the iron of which the pot was composed. Our metallurgical friend writes to correct the statement; the pots, he says, were 50- and 60-ton pots. Both engineers have in mind the same pots, and both are right. The welder with orange spectacles—we believe that is the color of the goggles he wears—saw an empty pot composed of 8 tons of cast-iron; the smelterman, whose mental spectacles were different in color, pictured the same pot full of molten metal, the weight of which, he knew, was about 50 tons.

OUR attention was drawn recently to a number of definitions of metallurgical apparatus that appear in 'A Glossary of the Mining and Mineral Industry', published in 1920. We select one of these to indicate the need for a revision before a second edition is published: "Dorr Classifier. A machine to diminish the amount of water required for classification by raking the heavier grains up an inclined plane against a light current of water, which washes away the lighter material. It is of the intermittent type". This travesty of an attempt to define a machine of such well-known characteristics as the Dorr classifier was taken from a handbook, a second edition of which has recently appeared; in this it is to be noted that no correction has been made to modify the definition to conform to current knowledge or interpretation. The handbook in question was written by a well-known and esteemed engineer; but, like all human effort, it is far from perfect. Several defects would be noticeable to a specialist in one of the many phases of chemical and metallurgical work, particularly in reference to descriptions of apparatus, all of which appear to have been transferred bodily into the 'Glossary'. The repetition of mistakes in second and subsequent editions of text-books is becoming increasingly common, and is due almost wholly to the dislike of critical reviews by those who proclaim that a reviewer who discloses error or mis-statement is merely advertising his knowledge as a specialist in order to triumph over the author.

ZINC or copper shingles, for roofing houses or other buildings, have many advantages. They are almost indestructible and require no protective coating. Repairs are unnecessary and maintenance costs are nil. They are now designed to meet the taste of either the utilitarian or the æsthete, and are oxidized at the plant in such a manner that color and texture can be produced to suit the fancy of the most exacting. Being of metal, the hazard of fire is avoided; moreover, they are easy to lay. No soldering is necessary, one nail per shingle being all that is necessary. The cost of the base metals is never likely to be so low again as it is at the present time. Copper shingles are made of what is known as nine-ounce sheeting, and roofing of this material weighs but 84 pounds per 100 square feet; the cost is about twice that of wood. Zinc is even cheaper, shingles of this metal being obtainable for little more than 15% in excess of the cost of wooden shingles, according to Mr. Harold Blake of the Anaconda company. Engineers in charge of new construction, house-builders, and those who foresee the need of repairs to their roofs in the near future would do well to study the comparative advantages of the various types of all-metal shingle being manufactured and now on the market.

LAST week, in our news columns, we published sundry remarks on the status of the silver market, taken from a speech delivered by Mr. F. W. Baker, chairman of the Mexican Corporation, Ltd., at its annual meeting in London. By the way, it is a pleasure to note that Mr. Baker has recovered from a recent severe illness and is able once more to attend to his many duties in the City. At the Camp Bird company's annual meeting, he made further reference to the silver market, emphasizing the point that the predominant factors are the trade balance of India and the needs of China. Upon the demand in the Far East the price of silver depends now as in the recent past. If this Eastern demand becomes normal and if European liquidation ceases, then, with the help of the Pittman Act, there should be a good price for the world's silver output. Mr. Baker made an interesting reference to a proposal, on the part of the Mexican government, to subsidize silver by means of a guaranteed minimum price for the silver produced in Mexico. He appears still to entertain some hope of this suggestion being put into effect. The melting of old silver and the liquidation of silver reserves in Europe have had a depressing influence during the last three or four years; it is reasonable to hope that this process of reduction is nearly at an end and that, per contra, the time is coming when the European governments will take steps to strengthen their monetary systems by adding to their silver coinage.

CONTRIBUTIONS to 'Discussion' this week start with an interesting and comprehensive account of the development of industry on the East Siberian littoral by Mr. Chester W. Purington, who, on account of his professional work in that part of the world, is thoroughly familiar with the regions that face each other across the North Pacific ocean. In order to enable the reader to follow his description we have caused a map to be prepared; this in itself will be of value by showing the geographic relations between Alaska, Japan, and Eastern Siberia. Mr. Purington wrote on his way to Yokohama. Next comes a timely letter from Mr. R. Allison Purvis, who writes from La Salada, in Colombia. He gives a vivid description of his experiences under the Soviet government, referring more particularly to the efforts to re-start the Russo-Asiatic enterprise, as reported in our issue of November 12. The flotation researches of Mr. Fahrenwald are discussed by Mr. A. C. Halferdahl, another specialist in that branch of technology. Mr. William Crocker writes from Phoenix, Arizona, on the distribution of plants as an indication of ore deposits, and links the presence of particular plants in particular localities with the character of their roots. Mr. Harai R. Layng advocates the use of volatilization methods in the treatment of the silver ore at Randsburg.

THAT the efforts to reorganize the world on a peaceful basis excite the interest of engineers is shown by the action taken a few days ago by the San Francisco Electrical Development League. The president of this organization is Mr. Robert Sibley, editor of the 'Journal of Electricity and Western Industry'. At a meeting on January 9 the following resolution was passed: "In view of the fact that Senator Hiram W. Johnson, United States Senator from California, has publicly stated that he is not in favor of the present limitation of armament as proposed at the national capital and is openly criticizing the proposed articles that have been drawn up by the Disarmament Conference, be it resolved by the San Francisco Electrical Development League, composed of 700 men interested in the development of central California, that we by open vote in our organization show our disapprobation of Senator Johnson's public utterances regarding the Disarmament Conference and hereby express to Secretary Hughes and his associates our whole-hearted and enthusiastic endorsement of the disarmament work of the Conference”. With this resolution, of course, we agree cordially. Senator Johnson's function in public life is chiefly vituperative; he is destructive, not constructive; his usefulness is largely at a discount at a time when most earnest men are co-operating for the purpose of rehabilitating a civilization that has been shattered by shell-shock. We join with the Electrical Development League in endorsing the good work done by the President and Mr. Hughes at Washington. In the furtherance of their purpose lies the hope of restoring industry, and bringing peace to a troubled world.

Spraying With Atomized Metal

The increasing appreciation of the usefulness of compressed air has facilitated research in connection with the application of protective coats of various kinds of adhering materials. Painting is now done by a system of atomization and spraying; the fire-proofing and the protection of timbers underground are effected cheaply by the use of the 'cement-gun'; the latest use of spraying is seen in the Schoop process, by which metal may be atomized and deposited by air on the surface of the article to be coated. The inventor, Mr. M. U. Schoop, describes the development of the idea in a recent issue of the 'Compressed Air Magazine'. Among the earlier tests was one in which he employed a small cannon to shoot tin and lead granules against sheet-iron plates, the idea being to form a protective coating. Later, molten metal was used in such a way that a thin stream was diffused and deposited by the atomizing action of superheated steam or air at high pressure. Subsequent work showed that satisfactory diffusion could be obtained with air at a comparatively low pressure. The use of metal in the form of dust or powder was the second step in the development of a practicable system, the material being projected by a stream of compressed air that was blown through a Bunsen burner of concentric design, the flame from which rendered the metal soft or molten. The primary idea was to find a means to utilize powdered zinc, which is available and cheap, for the galvanizing of iron and steel. The inventor next used metal wires, which could be melted by an oxy-acetylene flame, or by means of an electric current, and then sprayed and deposited by the impulse of expanding gases or by compressed air. Electricity proved to be the more flexible heating medium, because the temperatures obtainable by the use of the arc make it practicable to use a larger variety of metals for the purpose, some of high melting-points. The 'pistol' that is used carries two metal terminals, connected with the source of current; these are brought together and then separated so that an arc is formed. A suitable mechanism feeds the wires forward at the requisite speed. As the metal is melted it is blown, toward the object to be coated, by means of a jet of compressed air, delivered at a pressure of about three atmospheres.

In some cases powdered metal is obtainable at a low price, and is then used in place of the wire. The dust is delivered by compressed air into the flame of a specially designed oxy-acetylene burner, or an incandescent electric arc in which carbon electrodes are used. Mr. Sidney Mornington, who discusses the process in the 'Magazine', states that the projection and adherence of the metal takes place faster than do the reactions that are necessary to promote oxidation. It has been demonstrated repeatedly that lead can be fused and sprayed by means of a stream of heated oxygen, to form a homogeneous layer of metal, and without evidence of any oxidation having occurred. The 'pistol' weighs but 3.3 pounds; the electric machine consumes 40 amperes at 25 to 30 volts, together with about 18 cubic feet of compressed air per minute. The apparatus is mounted on a portable truck, which can be moved wherever spraying operations are necessary. A skilled workman can coat one square yard of surface in about six minutes.

The process has found extensive application for the galvanizing, as a protection against rusting, of bridges and railroad cars, the thickness of zinc deposited varying from 0.003 to 0.005 of a millimetre. High-tension porcelain insulators are partly coated with copper to ensure a satisfactory contact. Iron containers are protected with a deposit of aluminum, and thus the expense of the solid-metal article is avoided. Lead surfacing is adopted to protect apparatus from the corrosive effects of acid; a further use for the process may be predicted in connection with the coating of equipment that is used for the leaching of copper ores. An interesting application has been described in connection with the coating with lead of Pelton-wheel buckets. In one Swiss hydro-electric power-station it was found that the buckets were abraded by the sand and gravel in the water; experiments then demonstrated that buckets that had been coated with lead by the new process were peculiarly resistive to the abrasive action of the sand, the explanation being that the impact serves only to hammer the lead more deeply into the minute crevices on the surface of the casting. Other applications will doubtless be discovered, all of which will serve to emphasize the growing importance of the mining of copper, lead, and zinc, and the fact that expanding civilization and inventive genius will demand an ever-increasing supply of these primary essentials to industrial and domestic progress.

The Land of Our Children

We do not hesitate to refer to the Washington Conference again, even in a technical paper such as ours, because the subject is one that must engage the attention of every earnest citizen in this and in other countries. Moreover, the success of the Conference is exerting, and will continue to exert, a powerful influence upon the trend of business, including that of the mining industry, because the market for metals, especially in foreign countries, is linked with the restoration of amicable relations between the peoples of the earth. That reminds us of the proposed Economic Conference to be held at Genoa in March, when, it is hoped, measures will be taken to stabilize international exchange. This hope will not be realized merely by conversations across a table nor even by the signing of agreements. Many writers on this thorny subject seem to imagine that international exchange can be regulated by arrangement; one might as well try to make a summer by boiling the thermometer. Exchange is a symptom; it registers a condition; it is neither a theory nor a condition, but merely an indicator of the state of business between countries. What is needed to correct exchange and to prevent the fluctuations that now undermine international trade is a disarming of the bellicose peoples of Europe not only materially but mentally. So long as France asserts her intention to base her security on her strong right arm, and so long as the countries of eastern Europe threaten each other with armies the cost of which is sending them down the slippery slope to bankruptcy, there can be no exchange favorable to trade with the United States and other countries that are trying to put their own house in order and are endeavoring to persuade others to do likewise. Of France and the stand made by her representatives at Washington, we speak more in sorrow than in anger. She has gone far to wreck the Conference by her cynical pose, but that pose is an evidence of consistency, for ever since the War it has been claimed by her statesmen that the talk of international goodwill and world peace was mere idealistic piffle in face of a resourceful and unrepentant Germany waiting to redeem the recent failure of an effort to crush France and dominate Europe. Yet today France is beggaring herself by maintaining the biggest army in the world and is striving to supplement that army with a navy of excessive size, thereby spending not only her meagre funds but withdrawing from productive industry her young men, who ought to be engaged in useful work, while, across the border, Germany is spending nothing in men or money on army or navy, and therefore is able to apply her entire manhood to productive industry, the result of which inevitably will be to aggrandize Germany at the expense of France. To this a Frenchman would answer: We concede the point, but what is France to do in face of the German menace? The logical corrective, we submit, is an undertaking by England and the United States to protect France in the event of German attack. That is the one step that would do most to ensure peace. We have the Pacific pact, why not a similar European agreement? It is well enough for some of our people, represented by a powerful group in the Senate, to object to foreign entanglements, but what folly it is to object to such agreements during times of peace when it is inevitable that we will be drawn into them during times of war! Is it not better to undertake now to defend France from attack, and so prevent the attack, than be obliged later to join in a war resulting from the lack of such an understanding? If France and Germany fight again, the next war, like the last, will entangle the rest of us; why not therefore have a peaceful entanglement rather than another bloody Armageddon in the years to come? Surely the idea that we can remain detached from a world war is out of date; we are members of a comity of nations and we can no more escape the danger of participation in the next conflict than we were able, with the best intentions, to avoid entanglement in the last. Wireless telegraphy, the aeroplane, and the submarine have drawn the nations together with a nearness that is pleasant during times of peace but deadly during periods of strife. Surely that is one of the lessons of the Washington Conference. We have not only realized our place in the comity of nations but we have awakened to our responsibilities as the richest and most fortunate of all the nations. One reason why relatively we are the most prosperous nation today is that we escaped the full consequences of the War; we entered late; we made an enormous amount of money out of the belligerents before we entered; and the War ended soon after we entered; so our loss of manhood was comparatively slight, and even the cost of our military participation was compensated by our gains before and after we joined the belligerents. That is why today the United States is in a dominant position. The President and his administration realize the facts; they are availing themselves of our national predominance in their effort to restore peaceful conditions and to prevent further trouble. In all these matters it would be better if we could form the habit of looking at our country as the land of our children. It is well enough to be proud of the "founding fathers", as the President calls them, and it is natural that we should regard our progenitors with pride, but, after all, what we do now will not affect them. We hark back to the past too much, we look forward too little. Let the dead past bury its dead; the past is irretrievable, the future is measurably in our hands. Whether we agree to do certain things with Japan or with France, with England or with China, these agreements will not erase the history of which we are proud but it will determine our destiny in the years to come, and, more particularly, the happiness of our children, and of their children. This is the land of our children just as much as it is the land of our fathers. Because George Washington, at the birth of this republic, facing conditions that have changed entirely, voiced the proper desire for detachment from European squabbles, shall we today allow civilization to commit suicide, and permit conditions to arise that will involve the misery of our sons and daughters? This thought is truly American in that it brings all of us, native-born and alien-born, into close sympathy; for, whatever our own origin, our children are American and to them belongs the future of the United States.

Physical Work and the Human Machine

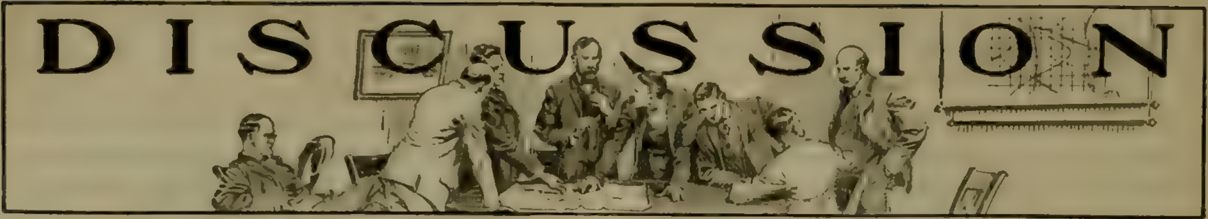
Engineers have devoted painstaking attention to all but one of the prime-movers in general use; the exception is the human machine—the most ubiquitous, complex, delicate, expensive, and troublesome of all. Familiarity with that engine, and the slight knowledge that is acquired so readily concerning its possibilities and limitations, accounts to a large extent for the neglect to study the problem. The engineer has been content to leave the matter to the physiologist, being unwilling to trespass on another's domain; but this view is challenged by Dr. H. Briggs, who recently contributed to the Institution of Mining Engineers an interesting paper on the relation between physical work and the efficiency of the human machine. He sees no reason for barbed-wire fences between the sciences; he believes that an occasional venture across the border is stimulating; no one would deny the benefit that has accrued to the mining industry from the incursions of such an eminent physiologist as Dr. Leonard Hill.

The human being is a complete portable plant that is capable of consuming fuel, of developing heat-energy by virtue of the chemical union of oxygen with the carbon and hydrogen of that fuel, and of converting a part of the heat-energy into mechanical energy. So far there is a parallelism between the human engine and a plant that consists of a boiler and a steam-engine. The likeness becomes more apparent when consideration is paid to the methods adopted in each case to avoid loss of heat; in both cases a lagging, of non-conducting material, is used, although the human being prefers to refer to his lagging as clothes. Here, however, the resemblance ends. The principle difference between the two plants—an important one—is in regard to the temperature at which chemical action occurs between the fuel and the oxygen. In the case of animals that temperature is low; and it is fixed with such definiteness that if it be altered to the extent of even a few degrees, either up or down, the organism is disabled. One effect of the relatively low temperature at which the vital processes proceed is that the amount of clothing worn must vary with the external temperature. In hot and damp places the need to expose as much of the skin as possible is so imperative that the nature of the clothing affects both the capacity for work and the safety of the worker. Too much lagging in such cases may wreck the machine. On the other hand, oxygen is consumed only in the boiler of an engine-and-boiler plant, not in the engine; in the animal the oxidation occurs over the entire system, particularly in muscles that are doing physical work. Air in both cases is absorbed and used continuously; the boiler is fed with fuel more or less continuously, but the man takes his fuel-supply at relatively long intervals, and finds it almost essential to cease work during the operation of stoking. He has a great storage capacity for fuel, but little for oxygen. If need be he can work for a long time after his supply of fuel is consumed; but he dies in a few moments if the supply of oxygen be stopped.

A striking difference is to be observed when air that contains a high percentage of oxygen is used in place of normal air. A furnace, if fed with such enriched air, would burn with greater intensity; it would consume a greater weight of coal per square foot of grate-area; it would produce little or no smoke; the output of steam would be increased. Nothing comparable with this occurs when a man breathes oxygen or highly-enriched air. Notwithstanding the popular belief to the contrary, he does not become intoxicated; there are no paroxysms of uncontrollable energy, to be followed by lassitude. If the air in a room be removed and replaced by pure oxygen of the same temperature and humidity, no one at work there would be the wiser if the change were effected surreptitiously. When a mine-rescue apparatus is used underground, for example, the mixture that is inhaled often contains 80 or 90% of oxygen; no deleterious results ensue. In his experiments on the subject Dr. Briggs found that, instead of a more rapid consumption of tissue, the breathing of cylinder oxygen made no difference in that respect when the person was at rest; it actually resulted in a slightly reduced consumption when he was doing work on a bicycle dynamometer; in other words, most people are a little more efficient as working machines when they respire enriched air. The human organism takes the oxygen it needs, and expires the remainder as though it were inert gas. It has been shown that when a healthy man starts to perform physical labor, the brain responds by accelerating the speed and pressure of pumping by the heart; the arteries in or leading to the muscles are dilated, to increase the circulation of blood in those parts. The extra supply of oxygen to the muscles at work is therefore derived, in the first place, from the passage of a greater amount of gas from the air in the lungs into the blood, and, in the second place, as the result of a more rapid transport of the oxygen, by the blood, from the lungs to the muscles. This question of the supply of oxygen to the muscles lies at the root of the study of physical work. To make hard work possible there must be an efficient co-operation of brain, heart, and lungs, in addition to a normal muscular development and the provision of sufficient nourishment.

Most of Dr. Briggs' experiments were performed with an ergometer, or bicycle dynamometer. This consists of the frame, seat, pedals, and chain-drive of an ordinary bicycle, which is supported on a wooden stand. The front wheel is absent, and in place of the back wheel there is a fly-wheel, around the rim of which passes a linen belt that acts as a brake. Adjustable springs are attached to spring balances. The gearing of the bicycle is such that when the pedals are turned at 56 revolutions per minute the increase registered by the spring balance multiplied by 1000 gives the work done in foot-pounds per minute. If a man does work on this machine, and if his exhaled air be collected, metered, and analyzed, certain facts are observable. It is found, for instance, that the proportion of carbon dioxide in the expired breath is not constant; it is lowest when the subject is at rest, and it rises as the rate of work increases, until the maximum is reached; and then, if harder work be given, the proportion of carbon dioxide present is found to diminish. It has been shown that there are conditions in mining that affect capacity for exertion; these are seldom found in other occupations. For example, the underground worker may have to labor in air that contains much carbon dioxide and an excess of nitrogen. The presence of carbon dioxide is supposed to militate considerably against effective physical work, but recent research indicates that its influence in this respect has been greatly exaggerated. The addition of, say, 2% of carbon dioxide alone is not detrimental; its effect is merely to augment the depth of breathing, and thus promote rather than impede the transfer of oxygen to the blood. A large proportion, such as 5 or 6%, added alone to normal air, reduces stamina and induces headache and fatigue; but with the percentages noticeable in the air underground nothing is to be feared from carbon dioxide by itself. Unfortunately it usually appears accompanied by other deleterious gases; it is always associated with a much larger and variable amount of nitrogen. It is only in connection with the use of mine-rescue apparatus that one can deal with carbon dioxide as the only intruder in the air respired. For those engaged in normal physical work it is more important that the percentage of oxygen in the air breathed should not fall below 19 than that the amount of carbon dioxide should not exceed 1½%. It is difficult to work for long periods in an atmosphere that contains only 19% of oxygen; in all but exceptionally fit young men a drop of even 2% in the proportion of oxygen present reduces the stamina of the worker and induces fatigue.

It will be agreed on all hands that the importance of physical fitness can scarcely be exaggerated in its bearing upon manual work. Other things being equal, the output of a fit man exceeds that of an unfit one; he performs the day's labor with less fatigue. Physical fitness and dexterity often go together, but the two should not be confused. Deftness is the result of training the brain and the muscles for a special task; it can only be acquired by practice. The training needed teaches one how to obtain the desired effect with a minimum of muscular effort, and therefore with a minimum waste of energy in the form of heat. Fitness, on the other hand, is a much more general bodily attribute. It can be developed—and indeed is best developed—by exercise, combined with close attention to certain common-sense rules of living. The human machine is most efficient when dexterity and fitness go hand in hand. Recent tests have shown that fitness is a measure of the efficiency of oxygenation of brain, heart, and muscles during exertion. A numerical rating of this can be found by the use of the ergometer, and by metering and analyzing the gases inhaled and exhaled. So far as Dr. Briggs' observations to date are concerned, the fitness of the healthy miner is over 70%, but no underground worker over 45 years of age was examined. This method of measuring fitness was adopted for army purposes in Great Britain in 1918. An analysis of the results of testing 100 persons, drawn from all grades of society, showed that the number of those whose physical fitness was below 40% was nil; between 40 and 50% it was 7; between 50 and 60% it was 12; between 60 and 70% it was 27; between 70 and 80% it was 23; between 80 and 90% it was 24; and between 90 and 100% it was 7. The mechanical efficiency of the human machine has been investigated by several physiologists, whose results are in fair agreement; the most efficient manner to measure the input of energy is by means of an estimation of the consumption of oxygen, one cubic foot of which is able to develop a definite number of heat-units, which are expressed easily as units of work, depending on the proportion of oxygen going to form carbon dioxide and the proportion going to form water. The gross efficiency is ascertained by dividing the figure so obtained by the external work that is done while the oxygen is being consumed. To return to an afore-mentioned analogy, the gross efficiency is equivalent to the brake-horsepower developed by the engine, divided by the power that is put into the boiler-furnace and is determined from the rate of burning of the coal and its calorific value. Considerable difficulty has been experienced in estimating efficiency in the case of over-load exertion, for the oxygen required is not all taken in during the period of exertion; a great deal is supplied during the panting period that ensues after the work ceases. Normal breathing is not resumed until several hours after a short spell of very hard labor; the condition resembles that which arises when an engine is given an unusually hard task and succeeds in doing it, by drawing upon the steam that is stored in the boiler; after the effort it is compelled to stop or to slow down until the pressure and reserve of steam have been restored. If, in these circumstances, the power transmitted by the crank-shaft were to be divided by the power generated as heat in the furnace while the engine was running, an erroneously high figure of efficiency would be obtained. If the gross efficiency of the human machine be corrected, when necessary, by taking into consideration the excess of oxygen that is consumed during the post-work period, and if the efficiencies as ordinates be plotted against loads as abscissae, a dome-shaped curve results; in other words, the gross efficiency increases up to the maximum and then declines. For most people the maximum efficiency obtainable when breathing normal air is about 20 to 23%; in the case of highly-trained men the efficiency may be much higher. The highest efficiency recorded during Dr. Briggs' experiments was 37%, which referred to a football player when doing work on the ergometer at the rate of 6500 foot-pounds per minute. Unfortunately the human machine cannot be worked for long periods at an efficient rate, because fatigue interferes. It is doubtful if the gross efficiency of most kinds of heavy manual labor exceeds 10%. Some kinds of work are performed more efficiently than are others. In general it may be stated that the efficiency is a little higher when breathing oxygen than when breathing air; the efficiency of the fit man exceeds that of the unfit one; and the efficiency of the person who is working at a task to which he is accustomed is greater than that of a man that is put to work on a job that is strange to him. The study of the relation between physical work and the efficiency of the human machine is leading to a better appreciation of the value of statistical data that will bear the acid test of critical scientific analysis. The human machine has been sadly maltreated, if one considers the care and attention that is paid to the regular and systematic indication of the efficiency of, say, an ordinary steam-engine; but it is evident that vague generalities, based on biased personal impressions and convictions, must eventually give way to definite statistics that are based on impartial research and the application of common-sense principles.



DISCUSSION

The East Siberian Littoral

The Editor:

Sir—Many persons appear to be under the delusion that since the murder of the Czar of Russia and his family and associates, the governmental fabric of the Russian empire has disappeared. Nothing could be further from the truth. The cloth is rent and torn in many places, but it is not destroyed; nor, to one who knows Russia intimately, does this fact bring any cause for surprise.

The communistic principle has always obtained in the Slav nature and mode of settlement, and was even remarked by Herodotus in his comments concerning the Scythian hordes. These ancient Scythians, the counterpart of the blonde Russian Slavs of today, herded themselves together in collections of huts just as their descendants herd together in villages today. When a migration was made it was made collectively by the entire commune just as in modern times entire Russian villages, not individuals, migrated to Siberia. The Russian Slav knows no form of land tenure except the holding of land in common with the others of the village. He desires no other form.

The Government, for many years, tried to induce the Siberian immigrants to pick out land for themselves, and live on it, each man and family on his own selection. The effort was a failure. Such efforts will always fail with the Russian Slav. He is the reverse of an individualist. He is not a home-seeker as much as he is a herd-seeker. As a rule he is not a pioneer, and has none of the qualities that go to the making of an adventurer.

The communistic principle in the days before the rending of the imperial structure was sometimes extraordinarily successful. The co-operative butter societies established by the Siberian peasants of the Obi region did business amounting to millions of pounds sterling with Denmark and England. The Loan Credit peasant banks paid high dividends and did great good among the farmers. Doubtless in European Russia, co-operative societies handling the grain, lumber, flax, and other commodities of their members were equally successful.

As regards the Russian laborer, countless examples could be cited to show that he could not work by himself, any more than he could live by himself. In order to get rid of a loquacious or lazy workman in Russia without the necessity of paying him for two weeks overtime in case of discharge, as the law required, it was only necessary to set the man at a task remote from his comrades, and he would quit within twelve hours. In 1914 at the Lenskoie gold mines, spacious and commodious bunk-houses were built for unmarried laborers to replace the old ones where seven or eight men were housed in one room with a stove in the middle, where cooking was done. Clean boarding-houses, after the fashion of American mining camps, were built for these men to eat in, meals being served as near cost price as possible. The men, after a short trial, refused to use either the bunk-houses or the boarding-house, preferring to herd in the old houses and in the old fashion.

The small band of Norse pirates who set up a strong central government in Russia in the tenth century at the ancient town of Novgorod were keen enough to recognize the herding spirit of the Slav millions. They did not combat this; they encouraged it, on the principle that it is easier to govern ten thousand villages than five million householders living on separate farms; in fact they established a government that endured, with one or two intermittent periods of anarchy, for a thousand years—and this in spite of raids and rapine by hordes of Mongolians, Tartars, Turks, Poles, and violent internal dissentions. How did this small nest of aliens at Novgorod, and their progeny later at Moscow and St. Petersburg, gradually through ten centuries extend the power of Russia over one-fifth of the surface of the earth, from the Baltic to the Pacific, and from the Arctic to the edge of Afghanistan? Simply this, by allowing the development of the commune within small limits, but never the spread of the commune beyond recognized limits. Russia, therefore, as we knew it in 1914 consisted of one hundred thousand republics, in each of which the individual could talk himself to death if he so desired.

The unrestricted use of the printing-press, the megaphone, and the moving-picture machine has changed all this. Similar machinery working among any other Asiatic people may quite conceivably be anticipated to achieve the same results, and the poison of bolshevism is already impregnating the body politic of Afghanistan, India, and the East Indies, fertile soil in which the soap-box orator may sow his noxious seed.

We come now to the status and achievement of the Russian on the Pacific coast of Asia. What has this achievement been? Practically nothing. In 1639 a party of Cossaks founded Anadyrsk, a fort 300 miles up the Anadyr river, and 800 miles from what is now Cape Nome. This was shortly after the English landed in what is now Massachusetts. In 1688, the year of the Revolution in England, Okhotsk was founded, and Petropavlovsk shortly after. These towns still exist, so do Boston, New York, and Philadelphia. They have had an equal time to grow. The settlements of the Russians on the east coast of Asia are today collections of a few huts. Those of the Englishmen and Dutchmen on the east coast of America are great cities, and from them has emanated a great and powerful people.

In the 18th century a few intelligent pioneers of Irkutsk (for even a horde of Scythians can produce a few pioneers) built ships at Okhotsk and Petropavlovsk and spied out Alaska for hunting the sea-otter. Vitus Bering, the Dane, was sent by Peter the Great to explore the coast, as were Krusenstern, Kotzebue, Chichagof, and Golofnin. A few Russian villages were squatted over the land, at Sitka, Saint Michael, Bogoslov, Unalaska, and even a Russian mission was established on the Yukon. There the Kamchadale and Sibiriak peasants brought their axes, their ikons, and their samovars, and built their monotonous wooden huts. There they sat, and their descendants are still sitting. The world witnesses no stranger sight than that of the bizarre imitation of Byzantine church domes modeled on Santa Sophia at Constantinople, rough-hewn with an axe, and still standing upon the bleak shores of Alaska.

In the early 'forties of the 19th century a spasmodic awakening at St. Petersburg was directed to the development of Russian interests on the Pacific. Fort Ross, or Russ, was founded in the Spanish territory of California, a considerable jump southward from Fort Wrangel, the southern Alaskan point. Doroshin, a mining engineer, was sent to find gold in Alaska. But the Russians, having established Fort Ross, went away never to return, and Doroshin, having spent two years and found only a little gold in Turnagain Arm, went back to the capital and wrote a two-volume book explaining why he did not find more. In 1867 someone in St. Petersburg decided it was high time to terminate the farce of Russian colonization in Alaska, and it was sold—for a mess of pottage.

The Seattle Chamber of Commerce estimates the total production of Alaska between 1867 and 1920, in minerals, fish, and furs, at $1,008,356,000. Who did this? Who thus added to the wealth and food production of the world? Americans, the descendants of English, Irish, and Scotch colonists, Scandinavians, Germans, French Canadians, Italians, Englishmen, even Russians and Poles, acting under the stimulation of individual effort: not acting as herds or droves. And still the Russian priest chants at Seldovia, at Unalaska, to his tiny flock, and the Aleut choir-boys intone Gregorian hymns.

We have seen that the system of colonization by village hundreds made no progress in Alaska or in north-eastern Siberia. Did it make any more on the southern Pacific littoral? It did not. In 1858 and 1860 Russia forced China to cede to her the whole of the left drainage of the Amur, and the Primorsk, 1500 miles of coast-line south of the 54th parallel, to the Korean border, a territory altogether as large as California and Oregon combined, and comprising one of the most fertile grain districts of the world. This was by virtue of the treaty of Aigun in 1858, and the treaty of Peking in 1860, at a time when China was hard-pressed by wars with England and France.

In 1853 Russian villages were established on Sakhalin island, and in 1855 a treaty was begun with Japan with the object of acquiring it. It was not until 1875 that this was concluded, the island being exchanged for the Kuriles. In 1903 the half south of the 50th parallel reverted to Japan by the treaty of Portsmouth, and in 1920, as penalty for the massacre of 800 Japanese at Nikolaievsk by Russian 'partizans', Japan re-occupied the northern part. Neither Russians nor Japanese have colonized the island, the Russians finding no better use for it than a convict settlement, and the Japanese in nearly twenty years of recent occupation of the south half have only established a few fishing villages, two wagon-roads, and 40 miles of narrow-gauge railway.

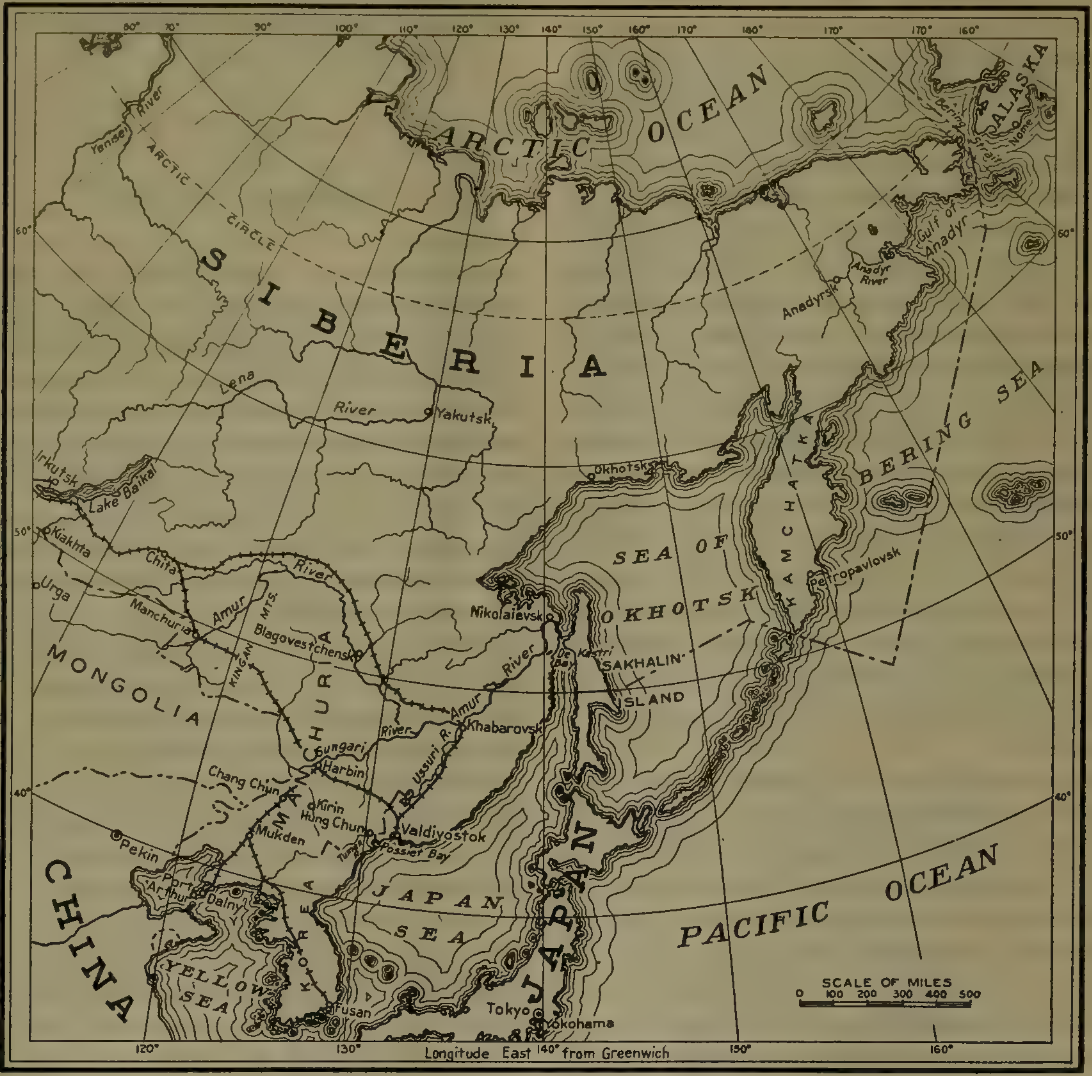
In 1860, Nikolaievsk on the Amur and Vladivostok on the Pacific were founded. With customary lack of foresight the Russian government located both these towns in the wrong places. Nikolaievsk, situated on the north bank of the Amur, 25 miles from its mouth, is ice-bound for seven months, while bars of shifting sand allow steamers of only 14-ft. draft to enter. Up to April 1920 it remained a mere fishing station, with a few government buildings of brick, with a 'naval port' a few miles below on the same side of the river. In 1920 the entire town was destroyed, 800 Japanese and 3000 Russians being massacred by the local Bolsheviks who were known as 'partizans'.

Vladivostok was not founded as a commercial port but as a military and naval base, and it remains to this day a hideous barracks, its background of forest cut down for 100 square miles in area, with no drainage, no water system, and no commerce, although occupying a magnificent harbor-site. The proper entry to the Amur river is 100 miles south of Nikolaievsk, at De Kastri bay, where seven months of open water obtains, with deep and safe anchorage for the largest ships, and where a 12-mile canal would give entrance to the Amur by way of Lake Keezee, allowing vessels of 15-ft. draft to proceed 500 miles up the river to Khabarovsk and the mouth of the Sungari, on which is situated the city of Harbin. Of this the Russians have talked for fifty years.

The proper entrance to Manchuria from the Pacific is not Vladivostok, but Possiet bay, 60 miles south, just to the north of the Tiumen river, the boundary of Korea. A railway line from Possiet bay would pass at 40 miles through the populous city of Hun Chun, then direct to Kirin, Chang Chun, and so across Mongolia to Urga, entering Siberia at Kiakhta, not at Manchuria station, as does the present Chinese Eastern railroad. This line gives access from the Coast to the grain, tobacco, and soya-bean areas of Manchuria without the necessity of crossing the heavy grades of the Mali Khingan range, as does the present Vladivostok line to Harbin.

Experience has proved that Vladivostok cannot compete with Dalny as an export point for beans from Manchuria. The reverse would be the case with Possiet, on account of the shorter rail-haul from the loading-points, as compared with Dalny, and the easier grade as compared with Vladivostok. The probability is therefore that in the future Vladivostok while continuing to function as sea-port for the Ussuri valley grain, and for the Amur railway points, will be of secondary importance, and that the great Pacific port north of Fusan will be at Possiet bay.

We are considering a territory more than twice the size of Alaska, from the Lena river to the Pacific Ocean and from the Arctic Ocean to the border of Korea. Siberia has been described as the land of "unlimited possibilities". As this is true not only of the capacity of its inhabitants for political experiments, but of its natural resources, we may leave it at that. This area of roughly one and one-half million square miles remains as a reserve for humanity. Future generations will probably live to thank the crawling Russian bear for his sleep of centuries at the door of this treasure-house, and for his ability to bluff the world for three hundred years into letting him keep it.



A few diplomatic pen-strokes at Peking and St. Petersburg won for the Scythian peasant hordes a vast area and coast-line on the eastern ocean, which they received without enthusiasm. On the huge chess-board of the Russian empire certain pawns in the shape of peasant villages were moved, partly as exiles, partly as subsidized emigrants, to the eastern edge, and a few policemen were sent to keep them there. But the Slav, as he loves the prairie, has a terror of the sea, and of the mountains. The Steppe calls to the Ussuri peasant-farmer; to him the East is a weary land. Yet there exist Siberian-born men, or Sibiriaks, of energy and intelligence who have already wrought pioneer work, sometimes under well-nigh incredible difficulties. These men will be a factor in future development, and their stock will endure. Both they and their women possess a surprising ability to undergo cold and the rigors of the land in which they live. It is indeed conceivable that they will become the nucleus of a state that will command the respect of foreign governments.

Curiously, it is not in the cities, but in remote towns and villages off the lines of communication that these men and women are more often found. They do not know their own strength, and meantime their land is torn apart with strife.

It has been suggested that the Japanese might contemplate a colonization of the Ussuri and Amur districts of Siberia. To any one having the slightest familiarity with the habits of the Japanese peasant, this suggestion appears in the highest degree ridiculous. A campaign of education extending over at least one generation would be necessary in order to teach the Japanese rank and file to grow and eat temperate crops such as wheat, rye, buckwheat, potatoes, and oatmeal; and to raise cattle and sheep. The great handicap to the Japanese government today in finding an outlet for the congested population of south and central Japan is rice. Rice is grown and is eaten. The Japanese will go where he can grow rice, and where he can catch fish, but not where he has to endure the cold of, say, Winnipeg, or has to labor in the wheat field, or in punching cattle. If he would willingly lead the life of a temperate or rigorous climate, even such as the north of Scotland affords, there is plenty of room for the congested Japanese peasantry in Korea, in Hokkaido, or in Sakhalin. Any number of examples could be cited in proof of the above statements. As a matter of fact, it would be a most excellent thing, and would aid in the support and feeding of millions of people, if the Japanese could be induced to populate the great wheat-lands of the Ussuri and Zeya, to take the place of the slothful and incompetent south Russian peasant immigrants who now raise indifferent crops in those valleys. The peasants would be more than willing to sell out to them as they now sell out to the Chinese. Here would be a suggestion for the solution of the Japanese immigration problem, so thoroughly discussed in western America. But the desirable state of affairs above outlined is not likely to be realized.

It is even difficult to get the Chinese, far more adaptable to new conditions, to farm the wheat areas of northern Manchuria adjacent to the Sungari river. An American farm expert has been in Harbin for several years trying to induce such colonization, but with poor success. Neither of these races inclines to a meat and fat diet, and without such it is impossible to support the cold.

Yes, you will say, all this is very interesting, but where are we getting? We are getting to this: That as it was the Norse stock which in the old days brought order out of chaos among the Scythians, from Moscow to Byzantium, it will probably be the Norse descendants—rather than the Slav, Mongol, or Malay descendants—who will bring economic order and development in Eastern Siberia. The ideal government for such a region is such an one as is administered in western Canada, with a minimum of physical and a maximum of moral force. As it is not easy to get up flag-waving enthusiasm concerning a country in which there is less than one-half an inhabitant to the square mile, it matters little by what nation the government is administered, so long as the individual is allowed to pursue his vocation with a reasonable amount of safety for his undertaking. It also matters not at all what nationality shall predominate among the miners, farmers, timber-men, and fisher-men of Eastern Siberia so long as they are actuated by individual incentive, as has been the case in northern Canada and Alaska. Russia tried to dominate the Pacific littoral by village communes interspersed with barracks, and made one of the most signal failures in history. Now after three centuries north-eastern Asia has baffled her, and remains as inscrutable as in the days of Ghengis Khan. The conquest of this last great treasure-house of the earth's surface will consume years, possibly generations. It will be effected by the tools of industry, not by the sword.

C. W. Purington.

On Board S. S. 'Tyndareus', November 27, 1921.

Conditions in Russia

The Editor:

Sir—It was with very great interest that I read the correspondence you published in your issue of November 12 with reference to the negotiations which have recently taken place between the Russo-Asiatic Consolidated and the Soviet government of Russia. All of us who have lived in Russia and have got to know and understand the people of that immense country must have the deepest sorrow and sympathy for the millions who are suffering for the sake of a few idealists and followers of men like Marx and Lenin. Mr. Urquhart in his letters to the shareholders and to Krassin clearly defines the reasons why it is impossible to resume operations under a government that rules with such tyranny.

I, myself, am an old employee of the above-mentioned company, was in charge of the Ekibastus mine until November 1919, when the Bolsheviks re-captured Omsk and it was necessary to get out. In January of 1920 I was captured, along with the British and American railway engineers who had been operating with the Kolchak government at Krasnayarsk, between Omsk and Irkutsk. After suffering severe hardships, and when the last of our personal belongings and clothing that could be spared had been sold or exchanged for food, we were compelled by hunger to register with the committee that had been formed for the purpose of reorganizing labor. By a decree issued by Lenin in January 1920 anybody who had not registered with this Central Committee of the Peoples Welfare was liable to be shot without trial. After registration, one option was given either to work where the Committee decided to send you, or enlist in the Third International. I myself was referred to the Mining Department and given employment under the Geological Department, the president of which was a Russian of the old régime and a member of the Geological Academy of Petrograd, and who like myself had been compelled to join or starve. I spent an idle time drawing my daily food-allowance and doles in cash whenever I applied. I was unable to leave the town, otherwise I had absolute freedom, until one night about 11 p.m. I was rudely awakened by the most villainous looking individual in civilian dress accompanied by three armed soldiers and ordered to go with them. By instinct I recognized them as members of the dreaded Cherka; I was treated most brutally, scarcely being allowed to get into the few scanty clothes I possessed. At their headquarters I was stripped of everything while my clothing was searched; not finding anything, however, and being able to give an account as to how I came to be in the town (they knew I had been at Ekibastus), I was turned out into the street. The next day many members of what might be termed the professional committees were missing, including the president of my Department. I applied to the Central Committee to act on his behalf but was informed that they had no power to act in any matters concerning the Cherka. I was arrested on two more occasions, but each time, after being insulted, was liberated, the fact that I was a Britisher and a foreigner probably helping me. Many mining men I met would suddenly be missing; in some cases they would turn up, but many of them were never heard of again, some being murdered, while others were sent away to other places where, for political reasons, they were considered less dangerous.

After living in this atmosphere of uncertainty I was ordered by the Central Mining Committee to go to a place called Archinsk to make a report on some coal outcrops. All the Committee could do for me was to give me a document as to my errand requesting the commandant of the town to give a pass to leave, while he in turn gave me a chit to the commandant of the station asking him to allow me a place on the first train leaving for the west. After a great deal of trouble I managed on the third day to see the station commandant, who said that he could not tell me when a train would be leaving, it might be tomorrow, it might be next day, next week, or most likely next month; in any case I would have to arrange with 24 others to share a horse-car as there was no other available space. All the other rolling-stock was requistioned for transporting troops and foodstuffs into Russia, which was suffering from famine even then. I reported to my committee, but they were powerless to assist.

Later, I managed to get a further document allowing me to travel anywhere in Soviet Russia; so, armed with this, my appointment on the Mining Department, and my pass to leave the town, and with the assistance of a few friends I had made of the Bolsheviks themselves, in June of the same year I slipped across the Japanese lines at Chita getting back to England by way of China and the United States.

Apparently, after reading Mr. Urquhart's letters and noting the reasons he gives for the decision adopted by his company, the conditions under which one is able to work have not altered since the time I was there, and as long as such a government, which encourages murdering, looting, nationalization of property, amid the most appalling chaos, exists, it is just as well to keep out of the country.

When I look back on the prosperous days in Russia, especially the years 1911 to 1914, and its rapid downfall, commencing about 1916 until the present day, leaving millions to die of famine and disease, I can only say that the conditions are like a nightmare to the privileged few who have survived it and got out of the country. It is still a glorious country, however, and the Russian is a man I have the greatest admiration for, and I think the majority of us who have lived with them, are looking forward to the day, I hope in the near future, when we can go back and help.

R. Allison Purvis.

La Salada, Antioquia, Colombia, December 8, 1921.

Surface-Tension in Flotation

The Editor:

Sir—I wish to thank Mr. Fahrenwald for his excellent discussion of surface-tension in your issue of November 5. The matter is elusive.

Referring to Gibbs equation, $U = \frac{c}{RT} \frac{ds}{dc}$, where U is the concentration at the surface of the solution, c is the concentration in the bulk of the solution, s is the surface-tension, T is the absolute temperature, and R is the usual gas constant, it is of interest to note that the derivation of this equation is postulated on, first, an isothermal cycle, and second, on the law of osmotic pressure of Van't Hoff. It is well known that colloidal solutions do not give co-ordinate data for pressure and concentration from which the molecular weight of the dispersed substance or phase may be calculated. And although one may calculate molecular weights from measurements of surface-tension and concentration by means of Gibbs' equation, yet such molecular weights are probably erroneous in the case of colloids. This, I believe, was done for gelatine, and a molecular weight of about 6000 deduced, which figure has been used for several decades.

Many substances form disperse phases in suitable mediums. As a rule the surface-tension of the dispersing medium is lowered. However, measurements by Hatschek of the surface-tension of a number of colloidal solutions gave results at variance with values calculated from Gibbs' equation. Gum arabic gives a higher value to the surface-tension of the dispersing medium than the latter alone possesses. Gibbs' equation may be said to state the facts in a qualitative manner only. "If we designate the change in concentration of a surface as adsorption, and as positive when U is positive, as negative when U is negative, then it may be said that a dissolved substance is adsorbed positively when it lowers the surface-tension, and is adsorbed negatively when it raises the surface-tension." Freundlich also states ('Kapillarchemie', p. 60) that most inorganic salts raise the surface-tension of water; sulphates and carbonates raise it more than do chlorides and nitrates.

Mr. Fahrenwald asks for an explanation for the fact of higher values of dynamic surface-tension than the corresponding static values, and also for values higher than those for water, for a 0.025% solution of sodium oleate. Possibly, at such low concentrations, the sodium oleate is partly dissociated; and what is measured, in part, is the surface-tension of a very dilute solution of sodium hydroxide.

The value of equations for expressing the results of investigations on surface-tension and adsorption phenomena is considerable. Perhaps the best that can be hoped at present are purely empirical equations. The results of calculations of suitable constants for some such equation for several of the commonly used flotation-oil emulsions should be interesting and valuable.

A. C. Halferdahl.

Anyox, British Columbia, December 8, 1921.

Indicative Plants

The Editor:

Sir—In the past year a great deal has been written about plants as being indicators of mineral deposits. The idea seems to be that the difference in plants, in different soils, is due principally to a chemical difference. Without questioning that a chemical difference has some influence, I would like to call attention to a few points that seem to show that the character of a plant growing in a certain soil can be explained, in most cases, just as well by physical difference as by chemical.

A few miles north of Prescott, Arizona, there are a number of low gravel hills with a great deal of oak-brush growing on them. The brush is not distributed regularly, but in such a manner as to suggest that certain parts are more favorable to its growth than other parts. An examination shows that the brush grows best where the soil is the rockiest, principally on the steep slopes, where erosion has caused a collection of coarse material. The explanation is, I believe, that the coarse material causes a concentration and such a distribution of moisture that it is made available to the peculiar root-structure of the oak-brush. The roots of the brush are not adapted to extracting moisture and nourishment from a fine-grained soil. On the gentler slopes of these same hills, where the finer material from the steeper slopes has been dposited, grass grows best, and the brush not at all. The grass, with its numerous hair-like roots, is best suited to extracting moisture and nourishment from this finer-grained soil.

In Williamson valley, 25 miles from Prescott, there is a limestone formation alternating with clay. Cedar grows abundantly in this limestone, but not at all in the clay. What moisture enters the limestone is concentrated in the cracks, where the root-structure of the cedar is better suited to extracting it than that of almost any other plant. The moisture in the clay is disseminated, and nothing but a root-structure like that of a grass or a weed can extract it well.

Prescott is situated partly in a granite and partly on gravel. The pine-tree grows in the granite, but not at all in the gravel. The growth of pine ends abruptly with the gravel. The roots of the pine are suited to extracting the moisture concentrated in the cracks of the granite, but are not suited to extracting the disseminated moisture of the gravel.

Some time ago a man told me that his father had one of the rockiest farms in the State of Michigan, and raised some of the biggest crops. His explanation was that the gradual decomposition of the rocks kept up the supply of plant-food. I think the correct explanation is that the rocks make a soil suitable for the roots of the things planted in it, so that the plants can extract more moisture and nourishment. One can see a good example of this on the rocky malapai mesas, where grama and other grasses grow abundantly.

My conclusion is that the kind of plant that a certain soil will best support is determined to a great extent by the root-structure of the plant. It can be seen that a deposit of mineral having a different soil-structure from that of the surrounding country will favor the growth of a different kind of plant life, and would give the impression that the difference was due to chemical differences.

William Crocker.

Prescott, Arizona, January 1.

The California Rand Silver Mine

The Editor:

Sir—I note that in the excellent article under the above heading, Mr. Arthur B. Parsons suggests the use of chloridizing volatilization methods for the purpose of treating the concentrate in order to produce bullion and thereby reduce the great losses caused by shipping the concentrate to a smelter. I presume that tests have been made by the volatilization method on the concentrate and that results worthy of consideration were realized.

Chloridizing volatilization would produce better results on the raw ore than on the concentrate, why therefore precede chloridizing volatilization by a more costly and less efficient process when chloridizing volatilization alone is probably able to accomplish at least the same result as the two processes at less cost?

According to the article, the economic realization of 75.8% on $30 ore by straight flotation at a cost of $1.61 per ton for milling and $1.68 for water the net realization would be $19.45 per ton of ore, with no deductions for loss of concentrate in transit nor for the cost of sacking. In order to produce the same net realization by chloridizing volatilization methods, which would probably cost less than $2 per ton of ore, it would be necessary only to realize a metallurgical recovery amounting to 71.5% of the value in the raw ore.

A 100-ton chloridizing volatilization plant using my processes and devices, including the grinding equipment, would cost less to install and operate than the flotation plant. The cost of water alone in the milling-plant would probably be more than the operating cost of the volatilization plant. The sulphur in the ore would replace fuel to such an extent that probably less than 5 gal. of fuel-oil per ton of ore would be sufficient. That type of ore would treat much more satisfactorily in a large furnace than muffle-tests would indicate. I would anticipate low extractions from muffle-tests, but extractions of 95% or over in a suitable furnace would not be beyond the possibilities of practice.

Harai R. Layng.

San Francisco, January 7.

Magnetic Prospecting

By Walter S. Weeks

The utility of magnetic instruments for detecting and determining the position of deposits of mineral beneath the surface of the earth has long been recognized. However, the details of the construction of these instruments and the technique of using them are probably known to few engineers in this country; accordingly, I hope that I may be pardoned if I attack the subject in an elementary way.

For the purpose of exposition I shall confine the discussion to measurements in the northern hemisphere. I shall also assume that the poles of the needles of all instruments are of unit strength. The lines of force of the earth's magnetic field point in the horizontal plane toward the magnetic pole, and they dip slightly downward. The magnetic force may be divided into a horizontal and a vertical component.

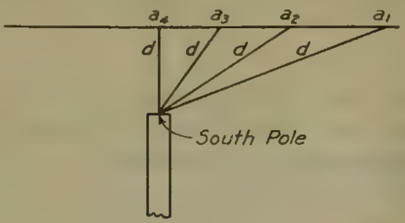


FIG. 1

If we have a magnetic lode buried in the earth, the upper part usually becomes a south pole, that is, it attracts the north-seeking end of a compass-needle. The attraction of the lode at any point may be resolved into a horizontal and a vertical component.

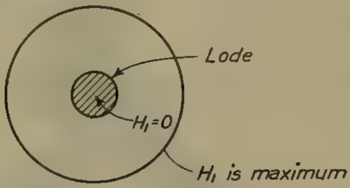


FIG. 2

Fig. 1 shows a pole beneath the surface of the earth. If a magnetic north pole is placed at a_1, the attraction of the two poles for each other acts along the line d and the actual force is equal to the product of the pole-strengths divided by the square of the distance between them.

Let us adopt the following nomenclature:

H = the horizontal component of the earth's magnetism at any point.

V = the vertical component of the earth's magnetism at any point.

H_1 = the horizontal component of the lode's magnetism at any point.

V_1 = the vertical component of the lode's magnetism at any point.

A 'neutral field' is one where only the earth's magnetism exists, and a 'disturbed field' is one in which there is a magnetic body.

At the point a_1 (Fig. 1) the horizontal component of the lode is great in comparison with the vertical component. Its actual value may be small because it is so far away. As we approach a point over the lode the actual pull along the diagonal lines becomes greater because d becomes less. At a point a_4 over the lode the pull along d becomes greatest but there is no horizontal component at this point. Somewhere between a_1 and a_4 the horizontal component is maximum.

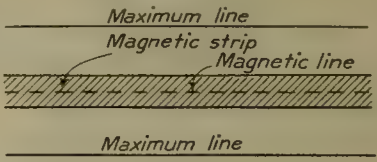


FIG. 3

The points where H_1 is maximum and the points where H_1 is zero are called critical points. Their determination gives us much knowledge of the location of the lode. The points where H_1 is a maximum are connected to form what is called a maximum line, and the points where H_1

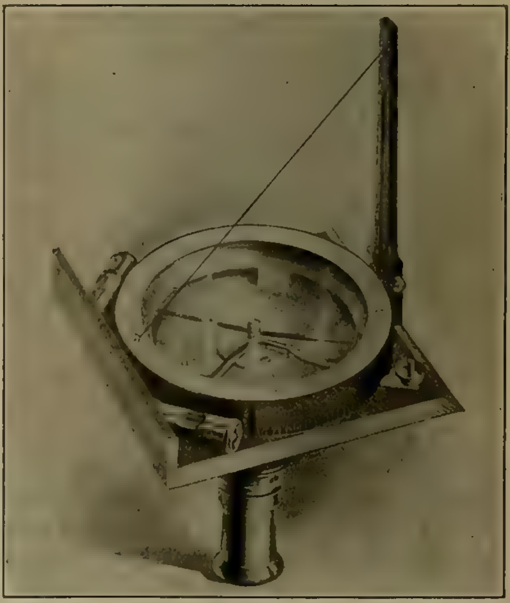


FIG. 4. DIAL-COMPASS

is zero are connected to form what is called the magnetic line. In the case of a single pole of limited area below the surface, the critical points would be as in Fig. 2. In the case of a vertical strip of magnetic rock stretching across the country the critical points would be as in Fig. 3.

If the strip is inclined, the maximum line on the side toward which it dips will be nearer the magnetic line than will the other maximum line. Relations have been worked out by which the depth may be calculated from the position of these lines. So it is seen that the horizontal measurements may be of great value.

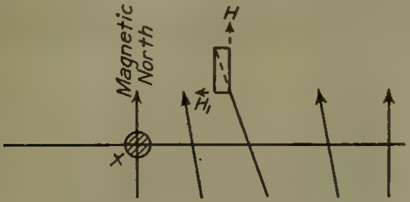


FIG. 5

The instrument used mostly in this country for determining the critical points is known as the dial-compass, shown in Fig. 4. It consists of an ordinary compass on which a sun-dial is superimposed.

The dial is set up to read the apparent time. The plane of the gnomon is then in the true north-south plane. If we know the declination of the compass, we know the direction of magnetic north. If the compass does not point to magnetic north, we know that some other force is acting on it.

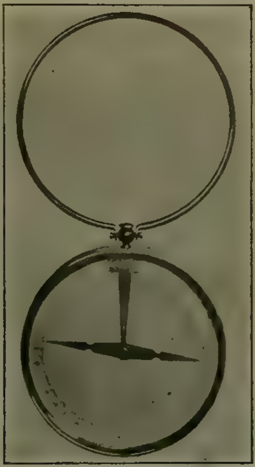


FIG. 6. DIP-NEEDLE

In Fig. 5, let X be a magnetic pole below the surface and let us approach it with the dial-compass from the east. When we are so far away that the orebody does not affect it, the needle points to magnetic north. As we approach the orebody the needle takes its position in the resultant of H_1 and H as shown in the figure. At the point where H_1 is a maximum we get the maximum deflection. Then, as we continue to approach the orebody, H_1 decreases and with it the deflection, until we are over the orebody where H_1 is zero and the needle again points magnetic north.

A great many surveys with the dial-compass have been made in the Michigan iron region. A great advantage inherent in the dial-compass is that no preliminary survey is necessary. At each station, true bearing may be determined from the sun-dial, and a good woodsman can carry and pace the line. With this instrument rapid work can be done in rough country.

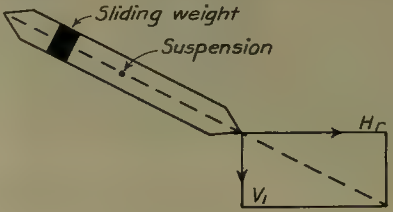


FIG. 7

An instrument called the dip-needle or dip-compass is used in connection with the dial-compass; one is shown in Fig. 6. The needle is pivoted at the centre of gravity, and it should have a sliding weight on the south end. When a reading is taken the needle is always held so that it revolves in a plane that is parallel to the horizontal magnetic flux at the point. The needle of the dial-compass shows the direction of this flux, so the dip-needle is held parallel to the dial-compass needle. Before using in a disturbed field, the compass is held in a neutral field, and the vertical component of the earth's magnetism is balanced by the weight so that the needle is horizontal.

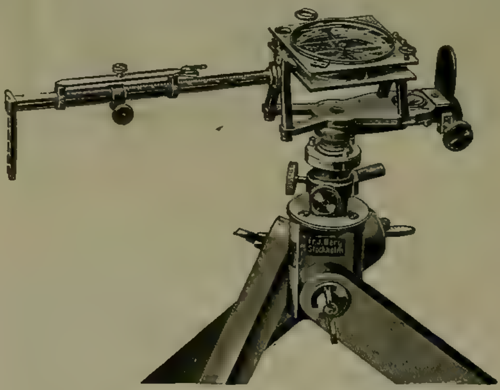


FIG. 8. THALÉN-TIBERG MAGNETOMETER

In a disturbed field its position is determined by several forces. The forces acting on it are the resultant of H and H_1, which we may call H_r, and V_1 the vertical pull of the lode; V also acts on it but is counteracted by the weight. The position of the needle will be determined by the resultant of H_r and V_1 (see Fig. 7). When we are very near the lode, V_1 is large and H_r is small, so the needle dips steeply. Theoretically it could never stand exactly vertically unless H_r was equal to zero. If the dip-needle were turned at right angles to the compass-needle, the influence of all horizontal forces would be removed and the needle would stand vertically at all stations. This is important to remember in comparing the dip-needle with the inclinator on the magnetometer.

In the Thalén-Tiberg magnetometer we have in reality two separate instruments: the magnetometer of Thalén which is used for the measurement of horizontal intensities, and the inclinator of Tiberg for the measurement of vertical intensities. These two instruments should not be confused.

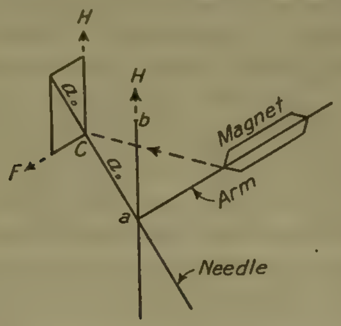


FIG. 9. MAGNETOMETER IN A NEUTRAL FIELD

Let us consider first the measurement of horizontal intensities. The instrument set up for measuring horizontal intensities is shown in Fig. 8. In this we have no datum-line such as is supplied by the dial-compass, but a fixed force is introduced instead. We see that the instrument consists of a compass mounted on a leveling attachment, and an arm on which is a sliding yoke for holding a small magnet.

The instrument is first taken into a neutral field. If the magnet is not in the yoke the needle points north. The magnet is inserted; it repels the north end of the needle and attracts the south. Only the north end need be considered in this discussion. The arm and compass-box are now turned until the arm is at right angles to the needle. The magnet is removed and the needle swings back into the north and south plane. The angle through which the needle swings may be made any desired angle by moving the yoke on the arm. It is usually adjusted so that the needle swings about 30°. This angle is called the neutral angle. The forces acting on the north end of the needle are shown in Fig. 9. F is the component of the repelling force of the magnet at right angles to the needle.

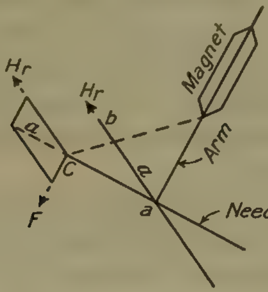


FIG. 10. MAGNETOMETER IN A DISTURBED FIELD

In the neutral field, with the magnet out, the needle takes the position ab, which is a north-south line. After the magnet is placed in the yoke and the arm is placed at right angles to the needle, the needle takes the position ac, which is the resultant of F and H. Now, when the magnet is removed the needle swings back to ab through the angle α_0.

$$F = H \sin \alpha_0$$

Let us now take the instrument into a disturbed field without moving the yoke. The forces are shown in Fig. 10. The needle with the magnet out will take the position ab, which is the resultant of H and H_1. The magnet is now placed in the yoke and the arm is placed at right angles to the needle. The needle now takes the position ac, which is the resultant of H_r and F. When the magnet is removed the needle swings back to ab.

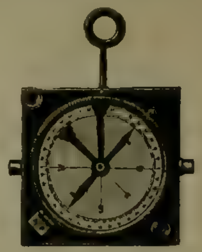


FIG. 11. TIBERG INCLINATOR

$$F = H_r \sin \alpha$$

$$\therefore \quad H \sin \alpha_0 = H_r \sin \alpha$$

$$\sin \alpha = \frac{H \sin \alpha_0}{H_r}$$

This is the formula that forms the basis for the discussion of the instrument; the method of operation is known as the sine method.

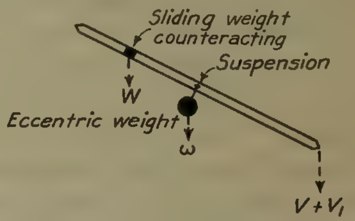


FIG. 12. TIBERG INCLINATOR IN A DISTURBED FIELD

Another method of using the instrument, called the tangent method, is not exact.

With this instrument we are able to find the points where H_1 is maximum and where it is zero. These, as we have said, are the critical points, so the magnetometer and the dial-compass accomplish the same result in a different manner. The magnetometer is not well adapted for use in rough country, because a survey that entails sighting is necessary to locate the stations. On the other hand, it has the advantage that it may be used on cloudy days. The instrument is sometimes modified by the addition of another arm, which is known as the Dahlblom 'sine-arm'. This arm makes easier the field-work in the sine method.

Fig. 11 is a picture of the Tiberg inclinator. This instrument is used for measuring V_1, the vertical component of the lode. The needle is pivoted above the centre of gravity as shown in Fig. 12. Any downward pull on the needle is opposed by the weight w. To eliminate the effect of the horizontal forces, the instrument is held at right angles to the needle of an ordinary compass. Then, only vertical forces affect it. The inclinator is first taken into a neutral field and turned so that the plane of rotation is east and west. Then only the vertical force of the earth acts upon it and the needle dips slightly. It is brought to a horizontal position by moving a sliding weight on the south end of the needle.

When the instrument is held at right angles to a compass-needle in a disturbed field, V and V_1 pull the needle down; V is counteracted by the weight on the south end, and V_1 is opposed by the eccentric weight; so if we know the constant of the instrument we can actually measure the vertical pull of the lode.

In the Thalén-Tiberg combined magnetometer we have two instruments: the magnetometer of Thalén and the inclinator of Tiberg. The same needle serves for both. The compass-box is mounted on bearings so that it may be tipped vertically when used as an inclinator.

To take a reading, the compass-box is placed horizontal and the arm is placed at right angles to the needle. Then when the compass-box is tipped to make the inclinator, the effect of all horizontal forces has been eliminated. The magnet on the yoke, of course, has nothing to do with this instrument and it should be removed.

There is another magnetometer known as the Dahlblom pocket-magnetometer, which can be used for measuring both horizontal and vertical intensities. The magnetic forces are opposed by a small spiral spring instead of by a magnet or eccentric weight. Still another instrument, the Thompson-Thalén magnetometer, is adapted only to the measurement of vertical forces; it does the same work as the inclinator. In this instrument, as in the Tiberg inclinator, the needle is pivoted above the centre of gravity. A small magnet is placed below the needle. This small magnet may be raised and lowered by a screw. Its position may be read on a scale at the top of the screw. The instrument is first set up in a neutral field with the plane of rotation of the needle perpendicular to the flux at that point. The magnet is moved till the needle is horizontal.

It is set up in the disturbed field in the same way. The needle is again made horizontal with the magnet, but, as the vertical component of the lode is now acting, the position of the magnet will be different. Its position may be read on the scale. If the constants of the instruments are known, V_1 may be determined.

In the 'Mining and Scientific Press' of September 24, 1921, Mr. Arthur Gibson discussed the application of magnetic measurements to the detection of magnetic minerals in placer deposits. I am inclined to believe that some of his statements are misleading. He says: "The old method of reading the angle of variation, deviation, or deflection in the horizontal plane, and the angle of inclination or dip in the vertical plane of the magnetic needle by degrees and fractions thereof, has been discarded, and a compensating or deflecting magnet has been introduced whereby much closer and more accurate readings are obtained".

It would seem that the deflecting magnet of the Thalén-Thompson magnetometer is confused with the yoke-magnet of the Thalén-Tiberg magnetometer. In the Thalén-Tiberg magnetometer shown in Fig. 8 all angles are read in degrees and fractions thereof.

When the sine-arm is used on this instrument, the angle a is held constant and the yoke-magnet is moved. The scale reads to millimetres. No greater accuracy is claimed for this method, but the field-work is diminished. The sine-arm has nothing to do with the vertical measurements, for these are taken with the Tiberg inclinator by the method described, and the angle is measured in degrees. So Mr. Gibson's statement applies only to the Thompson-Thalén instrument.

Mr. Gibson further states: "The horizontal measurements are of minor importance, but the vertical measurements furnish data from which valuable charts are platted . . ." This has not proved true in this country. The determination of the critical points of horizontal intensity has proved as useful as the determinations of vertical intensities. Moreover, if the horizontal measurements are of no value, why are the instruments constructed? An inclinator would be all that is necessary.

It is true that where the attraction of the orebody is very slight the vertical measurements may be of more importance. The nearest point to the orebody is directly above it; here there is no horizontal component. If we were to get far enough away to have the maximum horizontal component the attraction would be negligible on account of the distance. A sweeping statement, however, of the uselessness of horizontal measurements should not be made.

The first picture in Mr. Gibson's article shows a photograph of a Thalén-Tiberg magnetometer. It is captioned 'Thalén-Tiberg Magnetometer Provided with Tangent Arm for Reading Vertical Intensities'. The term 'tangent' is meaningless. The arm is used either with the sine method or with the tangent method. The arm, however, has nothing to do with vertical intensities. In the photograph which shows the instrument set up for reading vertical intensities it will be noted that the magnet is in the yoke. This, of course, should be removed. Mr. Gibson, I understand, has made surveys of placer deposits with the Thompson-Thalén instrument. If he would discuss in detail his experience in that field, I am sure he would make a valuable addition to the subject.

To those who wish to pursue this subject further I suggest the following discussions in addition to those referred to by Mr. Gibson:

'Magnetic Observations in Geological Mapping', Henry Lloyd Smyth, Trans. A. I. M. E., Vol. XXVI. Reprinted in U. S. G. S. Series, Monograph XXXVI.

'Magnetic Observations in Geological and Economic Work' (Part I), Henry Lloyd Smyth, 'Economic Geology', Vol. II.

'Magnetic Observations in Geological and Economic Work' (Part II), Henry Lloyd Smyth, 'Economic Geology', Vol. III.

Catalogue of Fr. J. Berg, Stockholm, Sweden.

In this article I have attempted to show only what measurements are useful in magnetic prospecting and to explain the principles involved in the design of the instruments. The literature, to which reference has been made, is ample for obtaining a full knowledge of the subject.

From some letters that I have received it seems necessary to point out that the instruments are of value only in detecting minerals that are distinctly magnetic and only when they are present in considerable quantity.

The dip-compass is the simplest of the instruments and is the only one that can be used to advantage by the non-technical prospector. It should be held parallel to the needle of an ordinary pocket compass. It is not essential that the dial-compass be used with it. Manifestly this instrument is not sufficiently sensitive to detect 'pay-streaks' unless they are very close to the surface.

Poisoning by Oxides of Nitrogen

The maximum percentages of oxides of nitrogen that may be present in mine air without harm to the workmen breathing it have not been clearly established, states a U. S. Bureau of Mines bulletin. Gaseous products from the use of explosives not only produce oxides of nitrogen but other harmful gases, such as carbon monoxide. L. G. Irvine found that in accidents due to the fumes of explosives, carbon monoxide accounts for most of the deaths, but nitrous fumes poisoning may also result and is the characteristic form of poisoning in accidents due to the inhalation of the fumes of burning nitroglycerin explosives. Incomplete burning or imperfect detonation causes carbon monoxide and nitrous gases; the former is produced in dangerous quantities after ordinary blasting operations.

Nitrous fumes are poisonous and of all gases are the most treacherous. Haldane exposed mice to 0.05% nitric oxide gas for 30 minutes and the mice were dead in 24 hours. The symptoms were the same whether nitric oxide or fumes of burning dynamite were used. E. A. Mann found 0.026% in mine air after blasting. Air containing enough fumes to cause irritation in the nose or air passages is dangerous. Irvine also states that a certain number of cases returned as pneumonia among underground workers are really cases of nitrous fume poisoning, and the intensely irritating character of nitrous fumes has suggested that the repeated inhalation of small quantities of this gas, by maintaining a catarrhal condition of the air passages and lungs, may be a contributory factor in the development of miners' phthisis.

Mann says that carbon monoxide and oxides of nitrogen occur together because they come from the same source. Almost all cases of gassing, therefore, are to some extent mixed poisoning. In practice, however, the symptoms of one or the other of these gases predominates sometimes to the exclusion of the appearance of poisoning by any other gas. Irvine says that in cases of poisoning by oxide of nitrogen fumes from explosives no symptoms may be evident and no poison or discomfort be felt for a time, yet within 12 to 18 hours after exposure the person exposed to the fumes may die from acute hemorrhagic oedema of the lungs. Carbon monoxide may contribute to some extent to deaths from poisoning by oxides of nitrogen fumes. The affinity of oxygen for nitrogen oxide renders its physiological action a difficult one to study.

The progress of the poisoning is described by Oliver as follows: During the inspiration of NO_2 there is a sensation of painful burning in the throat, which ceases when the fits of coughing have rejected the poison from the lungs. A few hours afterward, when it would seem as if all symptoms had ceased and all fear of possible complications had passed away, the individual who has breathed the gas begins to complain of severe compression of the chest and of respiration being painful, he becomes pale, temperature elevated, the pulse frequent and small, and the patient succumbs without loss of his intellectual functions. E. Black says that the effects on the air passages are instantaneous but the effect at the time is not so great that a man unaware of the real danger will endeavor to escape at once. On the other hand the effects that may develop a few hours after exposure are serious. Acute bronchitis and oedema of the lungs may set in, ending rapidly in death. Breathed habitually in small quantities and in great dilution it produces severe chronic diseases. In acute poisoning, immediate dyspnoea, tightness of chest, coughing, fainting, cyanosis, diarrhea, and collapse result. Death may occur in 40 hours, though symptoms of slight poisoning are delayed, in which case the first symptoms are headache, desire for fresh air, thirst, and then suddenly symptoms of an aggravated character, distress of breathing, anxiety depicted on the face, cold perspiration, protruding eyeballs, and spasmodic coughing that is followed by vomiting.

Persons should be removed from the vitiated atmosphere as soon as possible. In the case of oedema of the lungs, administer atropin. When oedema is absent, inhalation of water vapor and a little ammonia is recommended. In cyanosis, alkaline salt injection should be tried. Dr. Seyfert's observations show that chloroform administered internally in solution, immediately after exposure to nitrous fumes and at short intervals thereafter, is the most efficient treatment in such cases. Full doses should be given every half hour. The bulletin describes a method for determining small quantities of oxides of nitrogen. With a 250-cc. sample, as low as 10 parts of oxides of nitrogen (other than N_2O) per million parts of air can be determined with an accuracy of about 5 parts per million.

PANORAMA OF DISTRICT NEAR OROYA, PERU

Hydro-Electric Power-Plant at Oroya, Peru

By A. W. Allen

The Cerro de Pasco Copper Corporation's main power-plant is situated at Oroya, the junction of the Cerro de Pasco railway with the Ferrocarril Central del Peru. Oroya is at an elevation of about 12,000 ft. above sea-level, and is reached after a picturesque journey from the capital, Lima, in about 11 hours. The Ferrocarril Central was built by Meiggs, and forms a striking example of successful Andean railroad engineering; the branch line to Cerro de Pasco was built and is being operated by the Cerro de Pasco company. Among the streams that have their source in the snows and glaciers of the mountains on the Atlantic side of the high Andes is the Yauli river, the latent power in which has been utilized by the Cerro de Pasco company for extensive mining, milling, and smelting operations in various parts of the mountainous regions of Peru. Dams have been built to increase and hold back the water in the Morococha lakes, thus augmenting the supply from the Yauli river at times when there is a shortage.

For hydraulic and other reasons, Oroya was chosen as the site for the company's power-plant. About ten miles from there, at Chaplanca, a small reservoir has been constructed that serves to deflect the water from the river into a conduit of flume and pipe, which carries it to a large reservoir that is situated above and not far from the power-plant. The conduit traverses a rugged moun-

TAIL-RACE AT OROYA

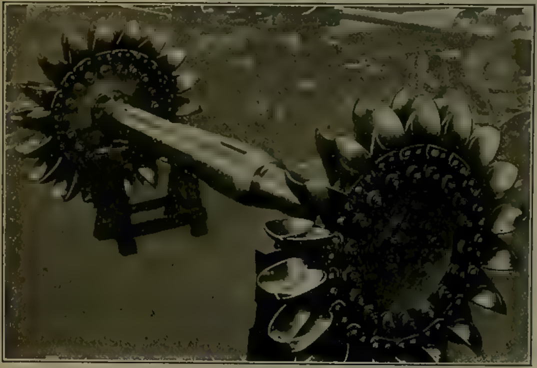
tain region; four tunnels had to be cut through the hills; the major part of the open flume is lined with concrete or rock, the remainder being built of wood. The pipeline is used to carry the water across the hills on each side of the Saco Quebrado gulch. The reservoir above the power-plant forms an artificial lake, which serves as a reserve of power in case of accident to the flume or pipeline; from here to the power-plant the water is conducted through a steel pipe, the first section of which is 62 in. diameter, the lower portion being 42 in. diameter. The pipe is about 4700 ft. long; at the steepest portion, for a length of about 1500 ft., it is held by anchors that are attached to concrete 'dead-men'. The pressure-pipe terminates at the bottom of the hill and near the power-house in a right-angled Y, the duplicate branches of which consist of steel pipe of 30 in. diameter, equipped with gate-valves. The water from each of these is again divided into four branch pressure-pipes, each of 24 in. diameter; each of these is again subdivided to supply water to the twin water-wheels that drive the generators.

An ideal site has been found for the power-house, which is built of reinforced concrete. The electrical equipment is in the form of four main generator units, two exciter sets, transformers, and switchboard. There is a separate installation of pumps, water-wheels, and motors to supply oil, at pressure, for the governors of the large water-wheels. The four main generator units consist of standardized equipment. Each main shaft carries two impulse water-wheels that overhang beyond the bearings. The twin wheels in each case are equipped with steel buckets of special design; the rated capacity of each unit is 5000 hp. at 300 r.p.m. and operating under a head of 700 ft. of water. The pressure-main terminates in deflecting nozzles and needles of the usual Allis-Chalmers type, which are controlled by means of governors that are operated by oil. If necessary, the water can be deflected entirely from the buckets, in which case it goes direct into the tail-race. The diameter of the nozzles can be altered to suit operating conditions and load requirements. One governor controls the two deflecting nozzles of a single unit, whereby speed is maintained constant by the precise and automatic regulation, not of the amount of water that is allowed to pass through the nozzles, but of the amount that impinges on the buckets. These governors are extremely sensitive and have given complete satisfaction. The oil used, which is maintained under a pressure that may reach a maximum of 250 lb. per square inch, is supplied by one of two rotary pumps; each of these is connected through friction-clutches with a water-wheel. The opposite end of each shaft is connected with a 35-hp. motor, which may be operated with current obtained direct from the main generators.

The four main generators operate at 300 r.p.m. and are each of 3750-kva. capacity. The current produced is of the usual alternating, 3-phase, 60-cycle type, and is de-

TRIPARTITE STEEL STANDARDS FOR HIGH-TENSION TRANSMISSION livered to the transformers at a pressure of 2300 volts. The generators are excited by current that is supplied by one of two exciter-sets, driven by water-wheels, or by motors; these water-wheels are each of 200-hp. capacity at 900 r.p.m., the water used being tapped from two of the 24-in. pipes that lead to the larger wheels; they are equipped with fixed nozzles, the supply of water to the buckets and the speed of the wheels being regulated by means of Woodward governors. The auxiliary motor connection is on the same shaft as the exciter and the water-wheel. The motors operate at generator voltage (2300) and are available for use in case of accident or the need for repair to the hydraulic equipment by which the exciters are usually operated.

Nine transformers, each of 1000-kw. capacity, are used to raise the pressure of the current from the generators to 55,000 volts, at which it is carried by No. 1 copper wire cables to Morococha, where there is a large concentrating plant; to Cerro de Pasco, where it is used in the mines, shops, and at the new concentrating plant; to Fundición, where it is used to operate the smelter; and to the coal mines at Goyllarisquisga and Quishuarcancha, near Cerro de Pasco. The high-tension lines are carried on tripartite steel standards of light weight and strong construction. An adequate telephone system is maintained, the wires being carried on separate T standards.



DOUBLE, OVERHUNG WATER-WHEELS, EACH 74 IN. DIAMETER, 5000 HP. AT 700 FEET

The plant is a credit to the designers as well as to the manufacturers; I am indebted to the Allis-Chalmers Mfg. Co., of Milwaukee, for details of the equipment.

THE character of the ore at the Laloki and Dubuna mines of the New Guinea Copper company is such that it has been found impossible to ship it in a green state on account of its liability to fire, the average contents being $4\frac{1}{2}\%$ copper, $2\frac{1}{2}$ dwt. gold, 10 dwt. silver, 40% iron, 40% sulphur, and 5 to 6% silica. The directors, in their report for the twelve months ended December 31, state that, as a rule, the sulphur and iron contents in basic ores such as these are paid for either by direct credits or by very low smelting charges. Obviously, therefore, the most profitable utilization of these ores is by their shipment to the mainland, there to assist in the economic smelting of the silicious ores within the Commonwealth of Australia. Erle Huntley, chief technical officer, after a series of laboratory experiments, has evolved a sublimation process which has been tested with entirely satisfactory results, and which he is confident will remove any possibility of the ore firing in the course of transit to the mainland. The directors therefore have under consideration the erection of the necessary equipment to give effect to Mr. Huntley's scheme, and they now propose to ship the ore direct to the mainland after treatment, in place of smelting at Bootless Inlet. Four or five months will be needed to erect the equipment necessary to deal with 3000 tons of ore per month. The company's railway from Bootless Inlet to the Dubuna mine has been completed, and a jetty and ore-bins, together with all necessary accomodation, erected at Bootless Inlet. The expenditure involved has been heavy. The board has offered to transfer the railway line to the Commonwealth government on payment of its cost to the company, but the government has not accepted the offer. The two mines, together with tramways, roads, plant, machinery, and buildings appear in the balance sheet as having cost £245,842.

MICA has been mined on a small scale in Argentina for many years, but it is only recently that the industry has received serious attention; in the five years preceding the War, 46 tons of mica were exported, of which the largest share went to Great Britain, the remainder being taken by Germany and Austria, states a consular report. In 1919 the exportation had increased to 145 tons, of which the United States took more than half. The mica exported is muscovite, from the pegmatites of the sierras of Cordoba and San Luis, occurring throughout the extent of the Cordoba hills and northward through the provinces of Catamarca, La Rioja, Tucuman, and the territory of Los Andes. All of the mining is done on a small scale by individuals with little or no capital, and the mica is sold to factories or dealers in Buenos Aires. The chief local use is in the manufacture of electrical heaters, although one small factory in Buenos Aires selects and cuts mica for phonograph discs and other uses. There are, however, no figures available on the production of mica for domestic consumption. According to one mine-owner, a metric ton (1 metric ton = 2204.6 lb.) of mica from the Cordoba mines will yield sizes as follows: Special, 15 kilos (1 kilo = 2.2046 lb.); No. 1A, 35 kilos; No. 1, 50 kilos; and in increasing proportion through the following five grades to 300 kilos of No. 6. According to the Argentine mining code, it is not necessary to own land to exploit the mica, mining rights being taken out by anyone locating the mineral, and therefore any American companies interested will not find it necessary to own mines. The numerous known deposits of the Cordoba hills, 200 miles west of the port of Rosario, are capable of being put on a producing basis if payment for the mineral can be made at the mine or railroad station. Lack of capital is holding back the workings. An American company well represented in the field could collect almost any desired quantity of Argentine mica for export in this manner.

The Hornsilver Mining District

By J. K. Turner

The Hornsilver mining district is in Esmeralda county, Nevada, about 30 miles south-westerly from Goldfield and 16 miles from Stonewall, a station on the Tonopah & Tidewater railroad and the nearest shipping point.

Wood and water are not found in the immediate vicinity. The former is not important as the ground requires but little timbering. Water has already been brought to the town of Hornsilver from the Goldfield Consolidated Water Co.'s lines by gravity. The question of a supply of water for the district can be solved without great expense.

The geology of the district is characterized by Cambrian limestones and calcareous shales that are intruded by diorite dikes. Intrusive granite is found in the higher mountains in the southern part of the district and it is their intrusion that has tilted the whole formation. The shale is interbedded with the limestone and the ores are found both in the shale and the limestone.

The most extensive formation is the limestone. It is compact and fine-grained, ranging in color from light-gray to almost black. At numerous places the rock is heavily stained by hematite and limonite.

The main veins of the district constitute an approximately parallel system cutting across the bedding of the shales and the limestone with a prevailing strike of about N. 60° W., and with steep dips. Although the wall-rock is either shale or limestone, the veins generally are parallel to some fine-grained and rather obscurely exposed diorite dikes. The vein-material is more or less oxidized.

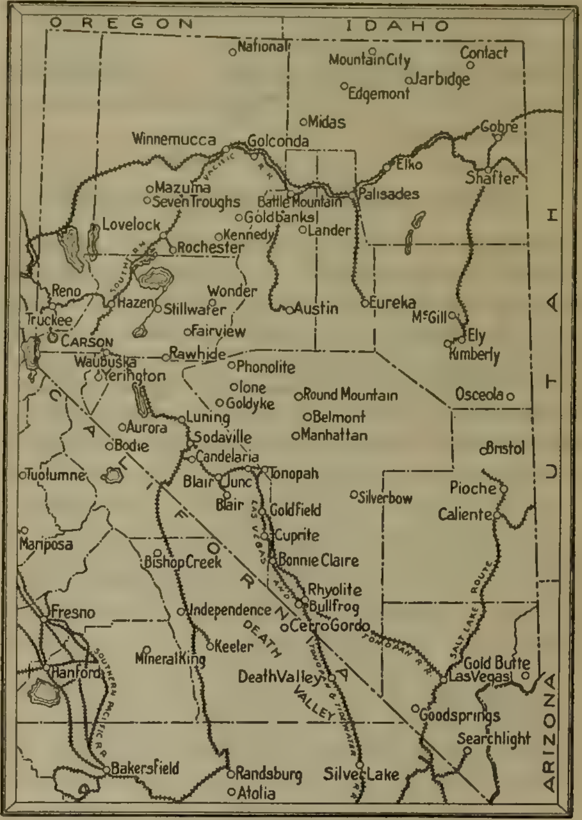
The quartz in many places is intensely crushed and the fragments have been re-cemented by limonite or chalcedonic quartz stained by iron oxide. It is apparent that the fissures, after being filled with quartz and sulphides, have been crushed by a later movement along the original dislocation, the vein thereby being rendered sensitive to oxidizing solutions. A distinct clay gouge separates the veins from the walls, which are unusually hard and smooth.

A marked characteristic of the veins all over the district is their regular strike, as shown wherever the 'wash' has been removed.

Silver predominates in the upper portion of the veins whereas gold predominates in the lower portion. It appears thus that there are two types of enrichment in these deposits. In one of them silver chloride is concentrated in the manganiferous oxidized ores of the upper levels, and gold is concentrated below. In the other, silver chloride is subordinate, whereas both gold and silver are concentrated below the oxidized zone. Possibly the difference might be explained if the amount of chlorine could be determined in the waters of deposits of both types. Silver chloride is soluble in an excess of alkaline chlorides. Those deposits in which hornsilver is not present may have been leached by waters unusually rich in chlorides.

The primary ore carries relatively little pyrite, and the inspection of a number of them gives the impression that the silicious ores are more favorable than the more highly pyritic.

In many of the deposits that carry gold, manganese is present in an appreciable amount, and the physical conditions seem to indicate a downward circulation; therefore it would be reasonable to expect an enrichment of gold below the silver-chloride enrichment zone. It was observed in some of the properties where both gold and silver are present in quantities that the outcrop and the oxidized zone for a distance below are leached of both metals. This would indicate the presence of strong acid-sulphate waters at one time.



The valuable constituents of the deposits are gold, silver, and lead. The last, as yet, is exposed only in a few places and in small quantities. The silver is found as cerargyrite (silver chloride, also called hornsilver) and sparingly as bromyrite (silver bromide). The lead as galena (lead sulphide), and cerussite (lead carbonate). The gold is found native.

The district covers a large area. It is not a new district, for an earlier camp known as Lime Point was located on the present site of the town of Hornsilver. The mines were worked over fifty years ago, but the poor milling-plants, the high cost of labor and supplies, and the long haul to the railroad at that time caused the district to be practically abandoned until the growth of Tonopah called new attention to this part of the State and provided better facilities than formerly existed for its economic development. It was again practically abandoned during the rush to Goldfield and other later districts. After these rushes subsided, interest again was taken in this district with renewed energy, resulting in deep development, exposing large bodies of ore and demonstrating persistence in depth.

There are two well-developed properties in the district: the Great Western, belonging to the Great Western Mining Co., and the Orleans owned by the Orleans Hornsilver Mining Co. The former has a gross production of over $500,000 and the latter of $450,000. Development in both properties has proved that the size and richness of the orebodies continue in depth. The Great Western produced from the 600-ft. level and the Orleans is now producing ore averaging $15 over a width of 10 ft. from about the same level. The Great Western property is now closed on account of litigation.

Prospectors are busy on the hills. New locations are being made, and many new companies have started work or are making preparations to start.

Copper Mines of Eastern Finland

Negotiations have recently been carried on between the owners of the Outokumpu copper mines in eastern Finland and some German copper-mine owners for the lease of the Outokumpu mines or the sale of the raw ore from them, states a consular report. It is stated that enough ore is being produced at present in one month to suffice for smelting for one year, but that it is intended to double the productive capacity of the smelting works, in which case the production of two months can be utilized here and that of 10 months can be disposed of otherwise.

There is considerable opposition on the part of experts in this country to disposing of these mines or their products, as they are considered to be a valuable asset for Finland. Experts state that there are at least 8,000,000 tons of ore in sight. To the value of the copper contained therein is to be added the value of sulphur, zinc, and eventually also of precious metals, although the latter exist only in very small quantities. It is considered probable that the quantity of ore is even greater than that mentioned, as borings have shown a depth of 9 to 10 metres in some places. Experts say that if the mines are worked to their full capacity the production will amount to at least 6000 tons of copper per year, which is worth 12,000,000 to 15,000,000 gold marks, not counting the other products, of which the sulphur alone is sufficient to satisfy the requirements of Finland's paper industry.

The Outokumpu ore field is situated in the district of Kuusjarvi, 56 kilometres from Joensuu and 90 km. from Kuopio. It consists of a long flat layer of quartzite, which, according to borings already made, appears to be 2500 m. long and 200 or 300 m. wide, with a depth of 9 to 10 m., as stated above. The ore contains on an average 4 to 4.5% of copper, 27% of sulphur, 28% of iron, and approximately 1% of zinc, as well as small quantities of silver and gold. The mineralogical composition of the ore is on an average 12% of copper pyrite, 32% of sulphur pyrite, 15% of magnetic pyrite, 1% of zinc blende, and 40% of quartz.

Notwithstanding the importance of the deposits of copper and sulphur at Outokumpu, these mines have never been worked with much success. The ore was first discovered in 1910, and trial work began three years later. The following table shows the annual production of ore and of copper since 1914 and the value of the copper:

Year	Ore tons	Copper tons	Value of copper Marks*
1914	7,500	148.2	375,000
1915	9,800	157.1	580,000
1916	22,000	175.8	1,025,000
1917	15,000	145.6	1,140,000
1918	17,200	69.5	1,300,000
1919	11,000	15.6	138,000

*The normal value of the Finnish mark is $0.193, but it is now greatly depreciated.

The Outokumpu mines are owned by the Finnish Government and a private firm, the latter having been the owner of the land where the ore was discovered and the former having acquired its title through the discovery of the ore and researches made by a mining engineer on behalf of the State Geological Commission. The mines and the land were leased by the owners for a period of 25 years from October 1, 1917, to a joint-stock company organized by a foreign mining engineer for the exploitation of these mines. Owing, however, to the War and other causes the enterprise failed, and on December 3, 1920, the company filed a petition in bankruptcy. This was subsequently withdrawn and the shares redeemed by the owners of the mines, who allowed the company an extension of time for fulfilling the conditions of the contract. The owners of the mines and the company are now experimenting to determine what methods of working will be most advantageous.

THE persistently high cost of labor and material has forced manufacturers to give the keenest attention to every promising source of economy in production; for this, among other reasons, there has been a revival of interest in a unique welding system developed in Great Britain a few years ago, and since put into commercial operation, states the 'S. A. Mining and Engineering Journal'. This system depends upon the fact that if a piece of copper on an iron plate is heated in an atmosphere of hydrogen to the melting-point of copper, the copper will spread over the iron in a thin penetrating film, like butter on hot toast. So, if the copper is melted between two pieces of iron it welds them together in an amazingly intimate fashion, the copper film actually working itself in between the crystals of the iron. By this process machine parts which can most conveniently be made in two pieces can be efficiently joined together without the complication of screws. In effect it enables the cheapness of separate manufacture to be combined with the strength and convenience of the solid combination. Steam-turbine blades and the cage or body of a high-speed centrifugal governor for small steam-turbines are among the articles which have been made successfully by this simple and ingenious process.

Mining in Arizona and Utah During 1921

By V. C. Heikes

ARIZONA

*The value of the gold, silver, copper, and lead produced by mines in Arizona during 1921 was about $26,000,000, a decrease from $114,628,584 in 1920. As most of the copper-smelting plants were closed after March or April the output of copper was less than one-third of that in 1920. No zinc was marketed, the output of lead was abnormally reduced, and the output of gold and silver was only half that of 1920.

The gold produced by mines in Arizona decreased from $4,786,122 in 1920 to about $3,046,000 in 1921, largely because of the closing of the copper mines, but partly because of the smaller output of gold ore. Operations were continued at the United Eastern and Tom Reed properties, in the San Francisco district, Mohave county, but the output was somewhat less than in 1920. The United Eastern company produced about 60% of the gold output of the State in 1921. Of the copper properties, the Calumet & Arizona, United Verde, and Copper Queen mines were the largest producers of gold, though they were actively operated for only about three months of the year.

The mine output of silver decreased from 5,355,303 oz. in 1920 to about 2,179,000 oz. in 1921. As most of the silver is associated with copper ore the decreased output of silver was due to the decreased mining of copper. The largest producers of silver were the Calumet & Arizona, Bunker Hill, United Verde, Copper Queen, United Verde Extension, Magma, and Commonwealth mines. There was much activity at Tombstone, even after the closing of the smelters at Douglas, as arrangements were made to ship the ore to El Paso, Texas. Much silver ore was also treated locally in milling plants. The C. O. D. mine, near Kingman, operated a new mill, and was a producer of considerable silver-lead ore.

The mine output of copper decreased from 558,256,302 lb. in 1920 to about 163,087,000 lb. in 1921. The value of the output decreased from $102,719,160 in 1920 to about $20,565,000 in 1921, owing to the curtailment of production and the decrease in the average price of copper from 18.40c. to 12.50c. per pound. The Consolidated Arizona smelter was idle throughout the year, and by May all the copper-smelting plants of Arizona were idle and most of the mines were forced to close. The Miami Copper Co., however, continued to make concentrate at the usual rate, and the International smelter resumed operations late in the year to treat the accumulated material. The leaching of copper ore was continued at the New Cornelia plant, at Ajo. The Copper Queen and Calumet & Arizona companies mined and shipped to Douglas a reduced quantity of copper ore after the smelting plants were closed.

The mine production of lead in Arizona decreased from 14,599,765 lb. in 1920 to 5,182,000 lb. in 1921. The value of the output decreased from $1,167,981 to about $238,000. No shipments of lead ore or concentrate were made from the Shattuck mine, which was the largest producer of lead in 1920. Much silver-lead ore, however, was shipped from the Copper Queen mine, especially from September to the close of the year, and the Bunker Hill Co., at Tombstone, shipped much lead ore as well as silver ore to El Paso.

As the demand for zinc was poor and the price decreased to about 5.11c. per pound, no zinc ore was shipped from mines in Arizona. The Arizona Hillside property in Yavapai county was idle.

The dividends paid by Arizona mining companies during the first 11 months of 1921 amounted to about $5,225,828, exclusive of $2,475,000 paid by the Phelps Dodge Corporation, which also operated mines in Mexico and New Mexico. The companies that paid dividends were the Miami, United Eastern, United Verde, Calumet & Arizona, United Verde Extension, and Phelps Dodge Corporation, the last principally for the Copper Queen mine.

UTAH

The value of the gold, silver, copper, and lead produced from mines in Utah during 1921 was about $22,595,000, a decrease from $49,744,334 in 1920. The output of all metals was decidedly less than that of 1920, and the output of copper was less than one-third that of 1920.

The mine production of gold decreased from $2,014,556 in 1920 to about $1,794,000 in 1921. The gold produced from copper ore was decidedly less, and the producers of silicious ores containing gold and silver suffered from excessive costs and smelter restrictions. At Bingham and Park City the production of gold decreased slightly, but in the Tintic district the decrease was marked, as several large producers were idle for months. The United States Mining Co., at Bingham, greatly increased its output of gold from lead and copper ore, and its mine produced more than twice as much gold as any other mine in Utah. Second in gold production was the Deer Trail mine, at Marysvale, which also had a considerably increased output. Gold in quantity was also produced by the Utah Copper, Chief Consolidated, Eagle & Blue Bell, and Tintic Standard mines.

The mine output of silver decreased from 13,106,976 oz. in 1920 to about 12,366,000 oz. in 1921. The decrease in silver was especially noticeable at Bingham, Park City, and Ophir. The output from the Tintic district,

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*From U. S. Geological Survey.

however, was more than upheld, principally through the efforts of the Chief Consolidated and Tintic Standard companies. The Chief Consolidated mine, at Eureka, continued to be the largest producer of silver in the State, and the Tintic Standard followed closely. Other mines that produced more than 500,000 oz. of silver were the United States Mining Co., at Bingham; the Vipont, in Box Elder county; the Judge and Ontario mines, at Park City; and the Eagle & Blue Bell, at Eureka. One of the interesting features of the year was the large production of silver ore from the Park-Utah mine, east of the Ontario at Park City. The Tintic Milling Co., at Silver City, continued to treat custom ores by a chloridizing roast followed by leaching, and the Tintic Standard company, in the eastern section of the district, operated its new mill, using the same process. The Deer Trail mine, in Piute county, increased its production of silver, and shipments of silver concentrates from the Vipont mine, in Box Elder county, were also much greater.

The mine production of copper decreased from 116,931,238 lb. in 1920 to about 34,534,000 lb. in 1921, and the value decreased from $21,515,348 to about $4,354,000. The Utah Copper Co., which produces most of the copper of the State, was closed in April after producing about 25,000,000 lb. of copper during the first three months. The Utah Consolidated mine, at Bingham, was closed in March. The average price of copper was 12.61c. per pound in 1921 and the demand for the metal was small. The United States Mining, Montana Bingham, and Tintic Standard companies produced a considerable amount of copper.

The mine output of lead decreased from 140,838,113 lb. in 1920 to about 89,782,000 lb. in 1921. The value of the output decreased from $11,267,049 to about $4,130,000. As the average price of lead was about 4.60c. per pound, it was not profitable to ship lead ore unless it contained much silver. The largest producer of lead was the United States Mining Co., at Bingham, but the Utah-Apex and Utah Consolidated mines were idle. The output from the Tintic, Park City, and Bingham districts was decidedly less. The closing of the lead smelter at International in July seriously affected shipments from Ophir, Park City, and Eureka.

The mine output of recoverable zinc in 1920 was 8,157,739 lb., but market conditions prevented shipments of zinc ore or concentrate in 1921. It was not profitable to ship zinc ore to Eastern plants on account of the high freight-rates and decreased price of the metal. The electrolytic plant of the Judge Mining & Smelting Co., at Park City, was closed in November 1920, and zinc concentrate from the Judge mill was stored. Financial difficulties prevented the operation of the Utah Zinc Co.'s zinc-oxide plant near Murray, and at Midvale zinc concentrate from Bingham ore and old tailing were stored awaiting a better market.

In 1921 the mines in Utah produced about 1,970,000 tons of ore, a decrease from 6,800,180 tons in 1920. Of this total the Bingham district produced about 1,485,000 tons as compared with 6,067,180 tons in 1920. The estimated production of the district was 47,052 oz. of gold, 1,059,700 oz. of silver, 28,349,000 lb. of copper, and 24,000,000 lb. of lead.

The mines of the Tintic district produced about 316,000 tons, exclusive of iron ore, as compared with 332,635 tons in 1920. The estimated production of the district was 18,578 oz. of gold, 7,425,000 oz. of silver, 1,672,000 lb. of copper, and 32,543,000 lb. of lead. The mines that produced more than 5000 tons during the year were the Tintic Standard, Chief Consolidated, Eagle & Blue Bell, Victoria, Iron Blossom, and Dragon. The shipments of ore and concentrate from the Park City region of Utah decreased from 88,314 tons in 1920 to about 74,320 tons in 1921.

A table of figures furnished by the principal shippers gave an estimated output for the district of 3317 oz. of gold, 2,185,000 oz. of silver, 782,000 lb. of copper, and 16,425,000 lb. of lead. The output of ore in the Ophir and Rush Valley and Big and Little Cottonwood districts was greatly reduced, but more ore was treated in Piute and Box Elder counties.

The lead smelters at Midvale and Murray were operated at a reduced rate during the year. The copper plant at Garfield curtailed its output after the closing of the Utah Copper mine, but continued to receive much silicious ore. At International the copper plant was idle and the lead plant was closed in July. In August the freight on bullion was reduced, and by December the smelters had disposed of surplus stocks and were merely shipping the current production.

The dividends paid by mining companies in Utah in 1921 will amount to approximately $4,613,930. Dividends amounting to $1,877,780 were also paid by the United States Smelting & Refining Co., which controls mines at Eureka and Bingham as well as mines in other States. The following companies contributed: Utah Copper, Chief Consolidated, Grand Central, Silver King Coalition, Eagle & Blue Bell, Tintic Standard, Gold Chain, Park Utah, Iron Blossom, and Eureka Hill.

Gold Production of South Dakota in 1921

The Homestake mine and mills, at Lead and Deadwood, South Dakota, began the year 1921 with increased activity and in April were working almost at full capacity, according to C. W. Henderson, of the U. S. Geological Survey. From May the operations continued at full capacity throughout the year. In May 1921 the Homestake resumed the payment of dividends, the first since September 1919. The Trojan mine and mill were in continuous operation throughout the year. The Golden Reward Co. moved the machinery of its cyanidation plant from Deadwood to Terry. Considerable development work was done at other properties during the year. The production of gold in South Dakota for 1921 was $6,464,000, as compared with $4,676,470 in 1920, and the production of silver increased from 90,795 oz. to 111,000 oz. No lead or copper was produced in the State in 1921.

REVIEW OF MINING

SAN FRANCISCO SECTION OF INSTITUTE ELECTS OFFICERS

At a meeting of the San Francisco section of the Institute, held at the Engineers Club on January 10, the following officers were elected for the ensuing year: Albert Burch, chairman; Theodore J. Hoover, vice-chairman; C. H. Fry, secretary; Jules Labarthe and Walter S. Weeks, directors. The usual dinner was followed by the presentation and discussion of a paper on asbestos mining in Canada and California by W. J. Woolsey.

COPPER PRODUCERS OPPOSE TARIFF ON PETROLEUM

D. A. Welch, representing copper producers in the South-West, including the Inspiration Consolidated, International Smelting, Greene-Cananea, Phelps Dodge, Arizona, Old Dominion, Miami, Ray Consolidated, Chino, Calumet & Arizona, and the New Cornelia companies, opposed the duty on oil at recent congressional hearings. He said it would impose a heavy burden on copper producers who could not afford additional expense for this important material. These copper producers consume 4½ million barrels of fuel-oil per year. The copper mines, with few exceptions, are closed. Copper is one of the principal exports, in normal times; 60 to 65% of the production is exported. Copper is not protected by a tariff. In 1914 much oil for use by the copper companies came from California, but due to diminished supply and increased price the producers found a new source of supply. The mid-continent field does not offer an oil supply of sufficient quantity and at a price which will permit copper producers to purchase. Welch said the South-West needs Mexican fuel-oil. With supplies costing 50% more and labor costs 50% higher than in 1914, while the selling price of copper is about the same, he said an oil duty would be a burden to an industry now struggling for existence.

MINING TO BE RESUMED AT JEROME, ARIZONA

Announcement has been made by Robert E. Tally, general manager, that steam-shovel work will be resumed at the United Verde within two weeks, with approximately 125 men employed in two shifts. A churn-drill is to be started at once, sinking holes for blasting. There has been a radical change in the plan of shovel-work. The original scheme was to remove the entire top of the mine to the depth of 300 ft. and then to excavate a pit of 200 ft. added depth. The new plan will involve the cutting of a shovel-channel clear through to the country rock; and the including of the oxidized deposits overlying the fire-zone. This oxidized ore is assumed to assay about 1% copper, but contains gold and silver. This will be stripped to the 160-ft. level, virtually exposing the smoldering sulphide ores, which then, it is expected, will be handled readily. Above the 400-ft. level it is estimated there will be handled 3,000,000 cu. yd. of ore and 4,500,000 yd. of waste. The initial trenching will necessitate removal of 100,000 cu. yd. The ores of this top stripping will be of diverse character and will include much old slag. Some ore will go direct to the smelter and other types will require milling.

Though there has been belief locally of early resumption of work by the United Verde Extension, the first authentic information was contained in a declaration at Los Angeles by James S. Douglas, president of the Extension company, that the mine will start within 40 days, employing 500 men and with an output of 1500 tons of bullion per month. Both the United Verde and the United Verde Extension smelters are in readiness for operation at any time, contingent, of course, upon availibility of the necessary skilled labor.

MICHIGAN COPPER MINES WILL RESUME ON APRIL 1

Advices from the Lake district indicate that the Calumet & Hecla, Ahmeek, Allouez, and Isle Royale companies intend to resume production of copper on April 1. It is stated that workmen will be engaged from time to time before that date as they are needed, to repair shafts, underground workings, and surface plants, in anticipation of active operation. The production for the first few months will probably not be more than half of normal, but the output will be increased gradually as the market warrants. The stock of surplus metal in the hands of the Calumet & Hecla company should be normal by midsummer.

YUKON GOLD STARTS OPERATIONS IN MALAY PENINSULA

The Yukon Gold Co. has commenced tin-mining operations in the Malay Straits Settlements. The initial month's operations show a recovery of 89%, against a predicted one of 80%. The company placed its first dredge in operation in September. Two other dredges, now under construction, should be ready for operation soon, after which it is planned to add a new unit every six months. From now on the company's main activities will be centred in the Federated Malay States, according to the 'Boston News Bureau'. Estimates place costs at 20 to 22c. per pound of tin. The present market price is 30c. per pound, but the average price for a number of years prior to 1914 was about 40c. The Government has placed a 30% export duty on tin, as a result of which the Yukon company will sell its concentrate in that market rather than ship to the American Smelting & Refining Co., with which it has close affiliations. Some time in 1922 the company will probably undertake some new financing to fund expenditures made in equipping the new Malay proposition.

As a result of the grant of valuable water-power concessions the company will have the only hydro-electric power property in the Federated Malay States. This will make possible a low cost of producing tin. C. H. Munro is in charge.

RESUMPTION OF PRODUCTION OF COPPER BY THE ANACONDA COMPANY WILL BE GRADUAL

When the Anaconda Copper Mining Co. resumed operations at four of its mines at Butte on January 16, 2000 to 2200 men were added to the number it has been keeping at work on development, upkeep, and preservation of the surface equipment during the shut-down. While its chutes and raises have been kept in condition, tracks, pipe-lines, etc., require some overhauling and it is not expected that the company will be producing copper before the middle of February, and then at the rate of only 5,000,000 lb. per month.

Mine officials state that it will be next year before the company is back to capacity production of between 25,000,000 and 30,000,000 lb. of copper and from 8,000,000 to 9,000,000 lb. of zinc per month. Because of the nine-month shutdown experienced men have become badly scattered and it will be many months before the mine organization is on an efficient basis. The labor unions at Butte received the wage-cut in good humor.

TRADE RELATIONS WITH EUROPE IN 1921 AND IN 1913

Europe is still our best customer; our transactions during 1921 considerably surpass those of 1913 figures, according to the Department of Commerce. The total value of our trade with European countries in 1921 probably approximated $2,380,000,000, as against $1,499,573,363 in 1913. The United Kingdom is our best customer; Germany has risen to second place in Europe as a consumer of American goods. Our exports to Germany during 1921 exceeded by about $25,000,000 our exports to that country in 1913. The final 1921 figures for Germany will show an increase in value over 1920. As compared with 1913, American exports to Italy in 1921 also show a great increase. Imports from Europe to the United States during 1921 were approximately $760,000,000, against $864,666,103 in 1913. American imports from France slightly exceeded in value those of 1913. Imports from the United Kingdom were slightly less than in 1913, whereas imports from Germany were less than half the pre-war figures.

Imports From

	1913	Estimated 1921
France	$138,933,883	$142,000,000
Germany	184,211,352	80,000,000
Italy	55,322,304	62,000,000
Netherlands	37,638,809	47,000,000
United Kingdom	271,954,987	234,000,000
Canada	142,127,982	337,000,000
British South Africa	3,066,349	8,000,000
French Africa	785,697	1,400,000
Total (Europe)	$864,666,103	$760,000,000

Exports To

	1913	Estimated 1921
France	$153,922,526	$225,000,000
Germany	351,930,541	375,000,000
Italy	78,675,043	214,000,000
Netherlands	121,552,038	170,000,000
United Kingdom	590,732,398	940,000,000
Canada	403,191,392	600,000,000
British South Africa	15,986,676	25,000,000
French Africa	2,232,479	13,500,000
Total (Europe)	$1,499,573,363	$2,380,000,000

APPRAISAL OF ANACONDA COPPER CO.'S PROPERTY BY PROFESSOR KEMP

Chairman Brooker of the American Brass Co. is sending to stockholders a report on the Anaconda property made by James F. Kemp, consulting geologist. After reviewing its productive capacity and the history of the mines in Butte, together with the geology of that district, Kemp makes the statement that the ores are of all grades from a general mining minimum of about 3% copper to a percentage of 10 to 15. The ore is carefully taken so as to use lower grades in times of high copper prices and higher grades in times of low prices. In this way the available supply is, and has long been, carefully conserved. This average grade has been maintained for 10 or 15 years. All the ore as mined is made up to a general average of about 3.3% copper. By oil-flotation the recovery is 96%, an exceptionally favorable showing. Allowing for further unavoidable losses in smelting and refining the recovery over all is 91.5% of the metal in the crude ore. In its operations the Anaconda company has opened over 2200 miles of workings and in normal years operates 23 different mines or shafts.

The continuation of the veins and of their values in depth is fundamentally important. The individual mines of the Anaconda company are of all depths from 500 to 3200 ft. The rich copper-bearing minerals continue unchanged in character to the lowest depth reached, and the silver shows no decline, but, if anything, a slight improvement in its ratio to copper. Ore-reserves indicated are of sufficient quantity to support operations on a normal scale for 15 or 16 years to come. Such a period of time is unusually long for a mining enterprise. The development in advance of mining indicates more ore blocked out today than was blocked out 10 years ago. All vein mines in the West are insatiable consumers of timber. The company now owns 1,150,000 acres in western Montana containing standing timber estimated at 6,000,000,000 ft. From 75,000,000 to 80,000,000 ft. of the output of the company's modern saw-mill are taken by the mines when running at capacity. Anaconda has secured several 'porphyry' deposits in South America and of the four properties the one in the most advanced state of development is at Potrerillos, in Chile. An orebody has been proved by drilling to contain over 128,000,000 tons of ore running 1.49% copper. The mine is already developed and the ore lies in such a way that as broken it will all drop downward to the cars, no hoisting being required. Allowing for losses in concentration and smelting, there is, roughly and safely, about 1,500,000 tons of available copper in this huge orebody. In conclusion Kemp says: "In my opinion, the present valuations, which have been the basis of negotiations with the American Brass Co., have been fairly and conservatively determined".

COPPER MINING COMPANIES WIN TAX-SUIT ON APPEAL

The United States Circuit Court of Appeals has upheld the decision of the United States Circuit Court, which held in favor of the Mountain Copper and Balaklala Mining companies of California in suits involving approximately $25,000 in taxes paid in Shasta county under protest. The copy of the decision of the Circuit Court of Appeals decision has just been received. The copper companies contested the action of the Shasta County Board of Equalization in raising assessments upon the company's properties. The Mountain Copper Co.'s assessment was raised from the figure of $135,000 submitted by the County Assessor to $589,000. The raise on the Balaklala company's property was in like ratio. The decision says: "The cases are such that it appears the Board of Supervisors disregarded all values and the report of the Assessor to the injury of the copper companies".

RUSH TO ELBOW LAKE, IN CANADA; 500 CLAIMS STAKED

The rush to this new gold camp 75 miles north of The Pas in Manitoba continues and at last accounts some 500 claims had been staked. The Hollinger Consolidated of Porcupine, which took an option on the Murray claims at a price stated at $150,000, has sent in a force of 25 men to start immediate development. The camp has attracted the attention of Eastern capitalists and a number of claims have changed hands at high figures.

PROMOTERS OF JEROME-SUPERIOR ACCUSED OF FRAUD

Accused of selling about $1,300,000 worth of stock in the Jerome-Superior Copper Co. whose property is at Jerome, Arizona, upon the representation that a drill-core containing a high percentage of copper had come from that mine, Melville Frasier, well-known Los Angeles attorney, president of the company, and George Mitchell, manager and chief engineer, were arrested on January 10 by Deputy Sheriff Fox on grand jury indictments. They are accused of conspiracy to defraud. The two appeared before Judge

Willis, who released them on bail of $5000 each, for appearance in court for arraignment. According to the district attorney who handled the cases before the grand jury, it is charged that the two and others asserted that the United Verde, one of the richest copper mines in the country, drilled into the property of the Jerome-Superior company, and obtained therefrom the valuable drill-core. On these representations, it is charged, a large amount of stock was sold in California. It is asserted in the indictment that the sample ore did not come from the Jerome-Superior property.

ARIZONA

Globe.—The Iron Cap Copper Mining Co. announced on January 12 that the mine will be opened for operation about February 1. The mining force is to be increased and operations resumed as soon as shipments of machinery arrive from the East.

Kingman.—The mine of the Hackberry Consolidated Mining Co. has been leased and it is to be unwatered and operated. G. S. Holmes, who is straightening out the legal tangle, has taken care of the Neagle sale of the property. The Hackberry mine was one of the first mines worked in the district. There is reported to be a large body of high-grade silver ore at the 300-ft. level. As development reached the lower levels the ore has changed to lead carrying silver.

Oatman.—Recent development at the Oatman United has opened high-grade gold ore. The assays from the last drill-hole averaged $90 per ton for three feet of vein. Two more holes are being drilled into the vein. This exploration is being done from a drift 900 ft. below the apex of the vein. Development work has been in progress at this property for many months.

During the month of Decemer the United Eastern Mining Co. shipped bullion approximating $200,000 in value and declared a dividend of 15c. per share payable to stockholders of record on January 9. This dividend is the fourth for the year, making the total disbursement of 60c. per share. A cross-cut is being driven at the 700-ft. level of the Big Jim mine. Ore is now being milled from the Big Jim and United Eastern mines and production is approximately 300 tons per day. At the No. 3 shaft diamond-drilling is still under way.

Prescott.—It is reported that an important find of ore has been made in the Arizona National mine near Humboldt. A small vein has been followed in a drift and later in a winze sunk from the drift. This vein has widened to 30 in. of silver ore, yielding 30 oz. per ton; 15 in. assays 500 oz. per ton. This find was made at the bottom of the shaft, which is down 330 feet.

Superior.—Not until March can there be resumption of ore production from the Magma Copper company's mine, where a 40% force is busy in concreting the main shaft and in fire-proofing the stations. The company is reported to be planning to broad-gauge its light railroad from Magma Junction on the Arizona Eastern and to install a reverberatory furnace for reduction of its concentrates and direct smelting ores, which heretofore have been shipped to Hayden and other smelting points.

CALIFORNIA

Grass Valley.—Ownership of the Banner property, east of Nevada City, has formally passed to the Banner Consolidated Mines Co., composed of New York capitalists. Approximately $172,000 is said to have changed hands in the deal. The purchasers have also acquired the Norambagua group. ——The old shaft at the South Star mine has been cleaned out to the water-level and placed in working condition. A. Hanker, superintendent, in charge of development work, reports the vein developed for a distance of 160 feet.

The Mountain Copper Co. Plant at Martinez, on San Francisco Bay

Jackson.—The Crocker Co. of San Francisco has completed preliminary work at the Elephant Deep hydraulic mine near Volcano and actual operations have begun. The company owns what is said to be one of the largest deposits of gold-bearing gravel in California.——At the Argonaut mine ore is coming from a depth of 4000 ft. It is stated that the ore is the best that has been mined for many years, and the bullion output is greater than any recorded since pre-war days.

Redding.—Daily shipments of ore from the Hornet mine to San Francisco bay have been increased to 500 tons. The tram-line from the mine to Mathewson, the new station on the Southern Pacific, will soon be completed. The owner, the Mountain Copper Co., also operates the plant at Martinez.

Rough and Ready.—The Alta Combination Mines Co. has already cross-cut 850 ft. from the old Baltic channel on Squirrel creek in search for the Alta Hill gravel channel. It is expected that the channel will be reached within the next few hundred feet. .H. L. Ostrander is in charge.

COLORADO

Boulder.—The Boulder County mill continues treating about 50 tons daily from the Potosi mine. Sufficient ore has been hauled to the plant so that operation will continue should snow block the road.

Buena Vista.—Henry Weber, lessee at the Gladstone mine, has installed a new compressor and completed the erection of a 50-ton mill and a power plant. New orebodies have been opened and the capacity of the milling plant is to be increased. The property lay idle for 30 years until Weber closed negotiations with the owners, Senator Sam Nicholson and Mrs. Herman, sister of the original owner named Burns who is now dead.

Cripple Creek.—The Cresson Consolidated company's annual report, covering the fiscal year ending August 31, but delayed in expectation that definite settlement of the income-tax case could be announced, has been made public. The report shows the shipment of 101,211 tons of ore with an average value of $12.98 per ton and a gross value of $1,313,938; net value after freight and treatment, $825,687.91; additional income, $342 royalty on 702 tons shipped by lessees, and $5299 interest on bank deposits. Total expenses were $400,084. The net gain from operations was $431,245. The total production cost per ton was $3.95. A. E. Carlton, president, reports net profits since the date of the annual report after deduction of all mining expenses, treatment, and transportation, but not Federal taxes, for September, October, November, with December estimated, to be $257,480, with cash in bank $806,688, and 18 cars of ore in transit of an estimated net value of $6000. The report was accompanied by checks for dividend No. 87, bringing the total in dividends to $8,979,102.

Lessees on the Ramona mine on Bull hill have uncovered at a depth of 55 ft. in the old main shaft, a three-foot vein, sampling as high as 2 oz. gold per ton. They have shipped a trial lot to the mill. The owners of the property recently incorporated under the name of the Ramona Mining Company.

Kokomo.—The Kokomo, Recen Mining & Development Co., owning property in the Consolidated Ten Mile district, near here, has opened a rich streak of silver ore, in one of the lower levels, assaying 700 oz. silver per ton. The ore was found in the Silver Queen mine directly under an old stope in the level nearer surface.

Rollinsville.—Drifting on the Homestake group in Gamble gulch in the Perigo section, the Nina Allen Mining Co. has cut a two-foot vein of free milling ore sampling $25 to $40 gold per ton, not including a narrow but rich streak several inches wide that assays as high as 100 oz. gold. This high-grade ore is being sacked.

Telluride.—Shipments of concentrate from Telluride mills for December totaled 130 cars, a record for the year. The Smuggler Union billed out 80 cars and the Tomboy 50 cars, all of the average grade.

IDAHO

Bay Horse.—The old Ramshorn mine is the best paying mine of this section of Idaho. The mill, which uses the flotation process, is making concentrate with a value of 400 to 500 oz. silver per ton.

Boise.—The value of gold, silver, copper, and lead mined in Idaho in 1921, according to estimates of the U. S. Geological Survey, was $15,208,000, a marked decrease from the value in 1920, when it was $31,170,176. As a result of the collapse of the metal market, many of the copper, lead, and zinc mines were closed. Only the high price of silver prevented the closing of the large mines of silver-lead ore. The mine output of gold in Idaho in 1921 was valued at about $497,000, as compared with $485,590 in 1920.

Clayton.—The property of the Idaho Mine Development Co., of which William M. Snow is president, has been examined by engineers representing Eastern capitalists, with a view to financing operations on a larger scale. Work is now centred on the Red Bird mine on Squaw creek. The mine, which is developed by tunnels to a depth of 900 ft., has an enormous tonnage of relatively high-grade ore already blocked out, with 10,000 tons mined and stored in surface dumps. The ore runs about 11% lead and 8 oz. silver per ton. Since the company was reorganized about a year ago, a 50-ton concentrating plant has been built and operated. The product gave a smelter return of 40% lead and 44 oz. silver. During the year 842 tons of concentrate has been shipped to Salt Lake smelters, totaling 653,310 lb. lead and 25,709 oz. silver. This operation has shown a profit, in spite of a haulage of 60 miles to Mackay, the nearest shipping point.

Coeur d'Alene.—The Sunshine Mining Co.'s mill on Big creek has resumed work. During the shut-down a flume has been built to carry the slime from the mill to the outlet of Big creek in the Coeur d'Alene river, a distance of more than two miles. This was done to avoid polluting the waters of Big creek, used for domestic purposes at Kellogg. A new ball-mill, a new set of eight-ton rolls, and a 580-cu. ft. compressor have been added. The centrifugal pumps have been replaced with elevators. The Stemwinder tramway, which was moved from Wardner to the Sunshine, was placed in position to carry the ores from No. 3 and 4 levels to the mill. The mill is of about 75-ton capacity. Ore in sight is said to be sufficient for two years operation. The mine and mill will employ 75 men.

At the annual meeting of the Sterling Silver Mountain Mining Co. the following officers were elected: R. L. Brainard; president; F. W. Miller, vice-president; M. Baumgartner, secretary-treasurer; Dan Krehbiel, John Krehbeil, Harry Morrell, and C. C. Schweer, directors. The main cross-cut has been driven more than 600 ft. and nearly 300 ft. of drifting has been done. Assays of picked samples from small stringers have shown 2½% lead and a high silver content. The company has 17 claims adjoining the Yankee Boy and the Yankee Girl.

The Bunker Hill & Sullivan company is installing a 150-hp. electric hoist. Each drum will hold 6500 ft. of ⅞-in. wire cable. The hoist will be equipped with a Maag cast-steel herringbone gear, capable of transmitting 200 hp. Each drum is equipped with power and hand brakes. The clutches are of the multiple-disc type. Indicators and safety appliances are of the latest Welch type.

According to H. B. Kingsbury, president, 2½ ft. of shipping ore has been opened in No. 3 tunnel by the Independence Lead Mining Co. Ore of milling grade had been followed for 80 ft. Several weeks ago a streak of higher grade appeared. Its width has increased as the drift has been advanced. The milling ore is 12 ft. wide at one point.

MICHIGAN

Houghton.—Ahmeek, the best of the Calumet & Hecla subsidiaries and the one that will yield the quickest return, probably will be the first to reach normal production. No. 2 shaft is being re-timbered to the bottom, and this task will be speeded as much as possible. Physically, Ahmeek is in good condition. There has been no serious caving and all stopes and drifts are accessible. Openings in Ahmeek's three normally-active shafts are in splendid ground, particularly No. 2. Stoping had already been started in these drifts when operations were suspended last spring, and it is from these stopes that a considerable increase is looked for. The fissure-vein is largely mass copper and great slabs of it can be sent direct to the smelter. The vein is narrow but is rich to a distance of 400 or 500 ft. from the Kearsarge lode. The draining of a small lake over No. 1 shaft will make possible the mining of the pillars and a limited amount of low-grade rock in that shaft. A large trench to carry off the water from the lake was dug during the past summer.

Although practically on a full-time basis again, Quincy is still working with reduced forces. Sufficient rock is being shipped to keep No. 1 mill busy, the number of shifts having recently been increased from four to six when the mine went back to six days per week. No. 1 mill has five heads, all of which are in operation. No. 2 mill, which has three stamps, is idle. Refined copper production, including mass, is now approximately 70% of normal.

While considerable work must be done in the conglomerate shafts of Calumet & Hecla before production can return to a normal basis, it is expected the amygdaloid shafts will be ready to resume hoisting without delay. The restoration of underground equipment and repair and re-assembling of surface-plants will not take more than six to eight weeks. No great difficulty is expected in recruiting sufficient labor to re-open the mines. It is estimated there are fully 3000 men available in the district and there is no intention of speeding production at the start.

Park Street, Butte

Repairs of extensive character are under way in the Red Jacket shaft of Calumet & Hecla. Two gangs of timbermen are engaged, working alternate shifts. The shaft has a tendency to crush where it passes through the vein.

MONTANA

Butte.—Under its agreement with the Anaconda company the Butte & Superior Mining Co. can ship at prevailing quotations at least 7,000,000 lb. of zinc monthly, beginning whenever it commences operating on a commercial scale. While Butte & Superior resumed on January 16, it will probably be a matter of at least 60 days before ore is being hoisted at the rate of 30,000 tons per month. The company, however, has been particularly careful to keep its underground workings well developed, and its hoisting machinery and surface equipment have been maintained in readiness for a 24-hour notice of resumption. On a production of 30,000 tons of ore per month, Butte & Superior will be operating at about the pace it did in 1920. It suspended production in December of that year, due to the lethargic zinc market, producing 91,642,260 lb. of zinc and 1,812,552 oz. of silver in the twelve-month. If average grade of ore hoisted is kept at about 14% zinc—it averaged 13.68% in 1920 and 14.68% in 1919—and 5½ oz. of silver per ton; and given an average recovery of 95%, Butte & Superior, when under way, will be producing 7,980,000 lb. of zinc and 156,750 oz. of silver monthly. Being a domestic producer, Butte & Superior will receive $1 per ounce for its silver under the Pittman Act. This will be no small credit to operations, and with the statistical position of zinc substantially improved, ere the summer months come around the company should be earning profits for the first time in many months.

NEVADA

Candelaria.—Six carloads of structural material for the new 300-ton milling plant have arrived at the Candelaria mine over the Inyo branch of the Southern Pacific railroad and the spur extending to the mill-site. The plant will be ready to start by June 1. Construction has been financed by a loan of $200,000 from the Rochester Silver Corporation, and some of the equipment, especially for the coarse-crushing plant, will be taken from the Rochester Combined Co. mill, now owned by the Rochester Silver Corporation. At the annual stockholders meeting of the Candelaria Mines Co. in Reno the directors elected were C. D. Kaeding, S. Rossiter, F. M. Manson, O. W. Jones, and J. C. Peebles. Kaeding is president and manager. The annual meeting date was changed to the third Monday in May.

Eureka.—The 15-ton test mill of the Eureka-Holly company will be replaced shortly by a plant designed to treat 50 and possibly 100 tons daily. The process is said to involve same 'revolutionary' features in treating silver-lead carbonate ore. Wide seams of high-grade ore have been exposed on the new 600-ft. level, and the consulting engineer, W. A. Barnes, says the reserve of mill-ore is between 70,000 and 100,000 tons. Some ore of high grade has been found in the Bullwhacker, working through the Holly shaft.

Mina.—Two kinds of concentrates are being shipped from the new 250-ton flotation mill of the Simon Silver-Lead Mines Co. The mill is working three shifts, and both in point of recovery and separation of the metals the selective-flotation process in use is said to be a success. Lead-silver concentrate, containing nearly all the silver in the ore, is shipped to the Midvale smelter in Utah. Zinc concentrate goes to the Simon smelter at Harbor City, California, where it is used in making zinc oxide. This plant is not yet ready for continuous operation. Mine development on lower levels has opened good ore at several points, a drift near the foot-wall showing a width of 12 ft. of high-grade ore.

Phonolite.—W. H. Kinnon, general manager for the Kansas City Nevada Mining Co., has taken to Fallon the first shipment of bullion from the company's mill. This bullion includes gold and silver from ores from the Mamouth and Broken Hills districts. A part of the ore treated was from the Broken Hills Silver Corporation. The next run will be on ore from the Broken Hills mine exclusively. For the past few days no underground work has been going on at the Broken Hills. The ore-bins and the mine are filled with ore ready for mill. As soon as the congestion is relieved work will be resumed in the drift on the 150-ft. level, where ore that will average $25 per ton has been exposed.

Rochester.—The current dividend of 2½c., by the Rochester Silver Corporation, checks for which are being sent to stockholders, makes a total of $220,000 disbursed since last June. Profits in recent months have ranged from $18,000 to $20,000 monthly, the net earnings for December having been $18,262 from a gross output of $60,540. J. A. Burgess has completed mapping the geology of the mine. A 5-ft. body of good mill-ore was opened lately by a raise from the 250-ft. level. In December the mill treated 5083 tons of ore assaying 0.133 oz. gold and 10.94 oz. silver.

Orders have been placed for new equipment for the Lincoln Hill gold mine, including an electric hoist. As soon as the machinery is in position sinking of the 85-ft. winze from the lower tunnel will be resumed. The winze is in good ore, with the vein said to be improving with increasing depth.——The mill of the Nevada Packard company is crushing about 6000 tons of ore per month. Several small lenses of excellent ore have been uncovered recently, and the physical condition of the property is declared excellent by the management. The Nevada Packard is operated under the supervision of Frank Margrave, the receiver for the company.

Round Mountain.—A new vein has been found by lessees working on the 700-ft. level of the Round Mountain mine. It lies parallel to, and 30 ft. from, the hanging wall of the Keane vein, the second most important in the mine; it appears to be larger and more highly enriched than the Keane vein and cuts the Los Gazabo vein at a depth of about 1100 ft. L. D. Gordon, the manager, has engaged miners to prospect the vein on other levels and may resume quartz mining on a considerable scale. Placer mining, to which the company has devoted its attention for over two years, yielded $125,000 last season. Abundant snow and additional water-storage provisions will increase next year's output of gold. The mill is operated by the company to treat the product of lessees.

Virginia City.—The 10,000-ft. haulage-tunnel of the United Comstock Mines Co. will be completed late in February or early in March. Hoar electric shovels are used in advancing the two remaining breasts between the Knickerbocker and Belcher shafts. Concrete work on the fine-crushing plant is finished and structural steel is arriving; the mill buildings are to be all of concrete and steel construction. A steam-shovel is grading for the cyanide building, the only part involving extensive rock excavation. Electric shovels were used in making deep cuts for belt-conveyors, extending from the haulage-way to the coarse-crushing plant and from the latter to the storage-bins of the fine-crushing department. The company has built a school-house and 20 cottages in the town of Comstock, in American Flat, near its mess-hall. The town has good drainage, water-supply, and electric lights.

At the portal of the Hale & Norcross tunnel of the 'Middle Group' of mines, foundations have been prepared for a compressor and complete mining equipment. Alex Wise, superintendent, is erecting camp buildings, carpenter- and machine-shops, a 16-in. blower, and an assay-laboratory, 16 by 32 ft. in size. A power-line has been extended to the transformer-house. The present working force of 25 men will be increased to 50 as soon as power-drills can be used. The tunnel, well timbered and in good condition, is 700 ft. long, and its breast is in the Comstock lode. It will be driven to the foot-fall and laterals will be extended north and south into the adjacent mines. The syndicate holding options on this group is composed of more than a score of men prominent in financial circles of the East. Acting through M. R. Ward, of Philadelphia, brother-in-law of Charles M. Schwab, they have provided $150,000 for sampling the properties and have agreed, if results of the sampling are satisfactory, to supply $3,000,000 for opening the mines and building a mill of 2000 tons capacity.

Work is in progress at many points in the district, new companies are being formed, many transfers of property have been recorded, and several new finds have been made. The Comstock Silver Mining Co., for which Frank W. Royer is consulting engineer, has opened an orebody of promise on the 265-ft. level of its Scheels workings, near the foot-wall of the Succor vein. For a length of 12 ft., ore from 20 in. to 4 ft. wide gave average assays of $67.51 per ton.——Two faces of ore have been exposed by the north-west branch from the lower adit of the Pittsburg Comstock Mines Co., adjoining the United Comstock on the west. Drifts have been started on this ore, in the North branch vein, and the tunnel is advancing south-west to cut the Bright Star vein, from which high-grade ore was stoped near the surface in early-day work. A third vein was cut by the tunnel, showing 12 ft. of good-looking quartz.——The Eldorado Comstock company has started work on the Lager Beer claim, south of the Comstock Silver group.——The Comstock Exploration Co. is driving the old O'Connor tunnel that produced some rich ore from the foot-wall vein west of the lode and near the Con. Virginia.

Yerington.—It is reported that the Nevada-Douglas Copper company is planning the erection of a flotation plant at the mines near Ludwig. Henry L. Moore, vice-president, and other directors of the company have visited the property, and the tonnage of sulphide ore blocked out appears to warrant the construction of a mill.

UTAH

Alta.—The Alta Tunnel & Transportation Co. is accumulating a reserve ore pile a few miles down Big Cottonwood canyon, where teams can go, under any weather conditions, thereby enabling the company to keep up steady production during the winter. Since the discovery of new ore in October, 500 tons has been shipped, averaging 37.17 oz. silver and 23.22% lead, yielding 18,592 oz. silver and 232,241 lb. lead. The gross value was $24,860, and the net returns, after payment of all charges, including mining, was $13,565.

Big Cottonwood.—Owing to heavy snow-storms, operations at the Woodlawn mine were discontinued temporarily. Development was resumed on January 7, and is confined principally to a high-grade silver-lead ore on the 700-ft. level. The ore is from 18 in. to 2 ft. in width, and the company is sinking a winze to follow the deposit downward.

Eureka.—Control of the Grand Central Mining Co. was acquired on January 13 by the Chief Consolidated Mining Co., according to officials of the latter organization. About three months ago Paul R. Hilsdale secured an option on the control of the Grand Central mine. Since acquisition of the option Hilsdale has been in charge of the mine. Surveying crews, geologists, and engineers were put to work examining the property and a large number of leases let. In the past month, under the leasing policy adopted by Hilsdale and associates, the production of the property has increased from two to three carloads weekly to ten for the period of seven days. Announcement was made on January 12 that the Chief Consolidated company had acquired the option and had purchased the controlling interest. The Grand Central mine, control of which has been held up to this time by C. E. Loose of Provo, has been a producer of a large amount of high-grade ore and is considered to be a property of great promise.

The initial shipment of crude fuller's earth was made by the Dragon mine to the Pacific Coast on January 4. Ore shipments for the week ending January 7 totaled 139 cars, as compared with 110 for the previous week; the decrease in both instances being due to the holiday season. The Tintic Standard shipped 52 cars; Chief Consolidated, 40; Victoria, 9; Grand Central, 8; Eagle & Blue Bell, 6; Iron Blossom, 5; Colorado, 5; Centennial-Eureka, 4; Dragon, 3; Sunbeam, 2; Swansea, 2; Alaska, 1; Eureka Mines, 1; Gemini, 1.

E. R. Higgenson and associates, who have a lease on the old Sunbeam property, shipped more than a hundred cars of ore during 1921. Most of the ore was of milling-grade and was sent to the Tintic Milling Co.'s plant; occasionally high-grade material, averaging over 100 oz. silver per ton, was mined and shipped direct to the smelters. All of the ore was mined above the 400-ft. level. This mine is the oldest in the Tintic district, and is owned by the Keith and Kearns estates of Salt Lake City.

N. W. Roberts, superintendent, reports that a second shift has been put to work at the Iron King mine. For some time past the company has been driving a drift on the 1565-ft. level through low-grade ore, averaging 9 or 10 oz. silver. Work has been started on the 1200- and 1300-ft. levels to cut this same vein.

The Tintic-Zenith Mining Co. will pay a dissolution dividend of 2½c. per share on January 21. There are approximately 680,000 shares outstanding, while the authorized capitalization is 2,000,000 shares. The disbursement will call for the payment of $17,111. The Tintic Zenith recently sold its property to the Apex-Standard Mining Co., which is developing its property in the eastern part of the district. With the payment of the dividend, the Tintic Zenith will pass out of existence.

Moab.—John Hill and H. W. Balsley recently shipped a carload of carnotite ore from the Yellow Circle mine, for which they were paid $3.75 per pound of uranium oxide. The shipment averaged 5%, and the net returns were between $8000 and $10,000. The ore was purchased by the Keystone Metals Reduction Co. and shipped to Pittsburgh, Pennsylvania, for reduction. This is the first shipment of carnotite ore from this district in many months. The Radium Company of Colorado is planning an early resumption of work on its Dry Valley carnotite claims. H. K. Thurber will be in charge of operations for the company.

Park City.—Ore shipments during the week ending January 7 totaled 1968 tons, of which the Judge companies shipped 837; Silver King Coalition, 776; Ontario, 355.

WASHINGTON

Spokane.—Gold, silver, copper, lead, and zinc ores, produced by the mines of Washington, were valued at $356,000 in 1921, compared to $200,320 in 1920, according to the U. S. Geological Survey. The output was less than any year in the past decade. Gold production increased from $120,860 in 1920 to $1,248,000 in 1921. Most of the gold came from the San Poil, Knob Hill, and Surprise mines at Republic. Silver decreased from 199,678 oz. in 1920 to 132,000 oz. in 1921. Mines at Republic, Nighthawk, Chewelah, and Colville produced most of the silver, but the quantity of silver produced from copper ore was unusually small, for the mill at the United silver-copper mine at Chewelah was not operated and the sunset mine was idle. Rich silver ore was opened in the Old Dominion mine near Colville and ore was milled by the Pyrargyrite and Four Metals companies in Okanogan county. Copper decreased from about 1,983,134 lb. in 1920 to 402,000 lb. in 1921. Crude copper-silver ore was shipped by the United Silver-Copper mine at Chewelah at the rate of 100 tons per month, compared to 300 tons in 1920. Lead production decreased from 5,787,247 lb. in 1920 to about 132,000 lb., valued at $6073, in 1921. Despite the low price the Northwest mine near Northport continued to produce zinc in 1921.

Valley.—H. F. Wierum, general manager for the American Mineral Production Co., operating the Allen magnesite quarry, announces that operations will be resumed immediately in order to fill orders on hand. At present the small kiln only will be operated; this will employ 20 men. It is hoped that a revival of industries throughout the country will increase the demand so that the force may be increased.

WISCONSIN

Cuba City.—The National Zinc Separating Co., manufacturing high-grade water-white sulphuric acid, has been running full time at a maximum capacity. A third unit is being added to the plant. Eventually a fourth will be constructed, when the full capacity will be 100 tons of 66° acid every 24 hours.

BRITISH COLUMBIA

Kamloops.—An important placer gold strike is reported from Mount Olie, south of the junction of the Grand Trunk Pacific and Canadian Northern railways. The strike was made on Lemieux creek, which flows into the North Thompson river near Mount Olie. A number of claims and leases have been filed.

Nelson.—The Ivanhoe mill of the Silversmith Mines, Ltd., was put into operation on December 31. At present about 125 tons daily is being treated; the capacity of the mill is 150 tons, and it is being operated three shifts daily. About 80 men are employed in mine and mill. It is understood that the product is to be divided between the Trail and Kellogg smelters.——For the quarter ended September 30 the Standard Silver Lead Mining Co. showed a surplus of $411,887, against $366,275 on June 30. The company has not been operating since it sold the Standard mine at Silverton, the increase being due to money received from Beer Sondheimer, in final settlement for zinc concentrate shipped months ago.

Pouce Coupe.—It is stated that the banks at Grand Prairie have consummated a deal, selling 20,000 acres of oil land adjoining the Imperial Oil company's well to Eastern capitalists.

Prince Rupert.—A tunnel is being driven at the Lion group, near Alice Arm, to cut at depth a 13-ft. vein that has been traced for 300 ft. on the surface. Samples from the vein have assayed 660 oz. in silver. The Kitselas Mountain Copper Co., which has been operating a property near Usk for some years, shipped a consignment of concentrate to the Tacoma smelter and has suspended operations until the spring, when it is probable that a new concentrating plant will be erected.

Stewart.—The Premier tramway has been put into operation. In the meantime the road has been broken, and the company has its teams and tractors hauling high-grade ore and concentrate from the mine and taking back heavy machinery.——High-grade ore is being sacked at the Silverado mine for shipment to Tacoma. This mine is now in a position to make regular though small shipments.

Trail.—During the last ten days of the year 12,415 tons of ore was received at the smelter, bringing the total for the year up to 411,612 tons. Of this large tonnage only about 10,000 tons has come from independent operators, and 3888 tons from mines in the State of Washington. A number of improvements have been made at the smelter during the year. The concentration of the Sullivan ore has been so improved that it is no longer necessary to handpick the galena from the blende at the mine. All ore is delivered together, and high-grade lead and zinc concentrates are obtained. The roasting of the zinc concentrate has been improved, with the result that a higher extraction of zinc is now possible. Improvements were made in the copper refinery, and the capacity of the plant was increased to 70 tons per day. At the present time, however, the company has no means of providing ore for this section of its plant. The copper output for the whole of last year amounted to a little more than 3,500,000 pounds.

Vancouver.—The Engineer Mining Co. has filed an appeal against the decision of Justice Clement, which gave the Engineer mine and plant to the heirs of Allan I. Smith, to whom the mine was left by the will of the late James Alexander.

ONTARIO

Cobalt.—The Right of Way has been unwatered and operations will be resumed by the Right of Way Syndicate.——Production of silver from the properties of the La Rose Consolidated is understood to have exceeded 400,000 oz. during 1921. A feature of the year's operations was a substantial reduction in operating costs.——The Bailey silver company is operating the Silver Cliff property under lease and is shipping ore from it to the Bailey custom mill. The Silver Cliff has approximately 3000 tons of broken ore ready for shipment and about the same quantity in the stopes ready to be broken. The gross earnings of the Bailey mill for 1921 were approximately $147,072.

Kirkland Lake.—The first report of the Kirkland Lake Proprietary (1919), covering the period from the date of incorporation in October 1919 up to June 30, 1921, indicates that the gold-producing stage is near at hand. It is expected that by April next the mill will be in continuous operation with a large reserve of high-grade ore available for treatment. S. C. Thomson, consulting engineer, states that the solution of the various fault problems has improved the possibilities of the mine, in that development can now be pushed ahead rapidly and economically. As regards the Sylvanite he says: "I consider this area the most promising undeveloped block of ground in the Kirkland Lake district". A report on the structural geology of the properties by W. H. Goodchild states that the central gold-bearing fracture-zone of the Kirkland Lake district traverses the Burnside and Tough-Oakes ground from end to end, giving a length along the strike of about 4000 feet.

On January 6 the Lake Shore shipped gold bullion valued approximately at $71,000 representing the production for a period of about five weeks. The output during December reached upward of $57,000, the ore recently treated yielding over $30 per ton.——The Kirkland Lake companies have not as yet followed the example of the Porcupine operators in reducing the rate of wages, and with the exception of the Kirkland Lake mine, which lowered wages some time since, are still paying the high scale.

Porcupine.—The new unit of the McIntyre mill, now in process of installation, is expected to go into operation in the spring, increasing the output to upward of $8000 every 24 hours. Plans for further additions to the equipment are held in abeyance pending the development of a larger supply of electricity.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Louis S. Cates, of the Utah Copper Co., was here last week.

Albert Doyle, of Richmond, Virginia, is at El Oro, Mexico.

E. H. Wedekind, of Lovelock, Nevada, is at the Plaza hotel.

F. W. Bradley has gone to Spokane, and expects to be away one month.

Glenn L. Allen has returned to Warren, Arizona, from Zacatecas, Mexico.

J. E. White is at Randsburg, examining the Uncle Sam group of gold-mining claims.

W. H. Goodchild has completed his geologic examination of the Kirkland Lake district.

R. B. Lamb announces a change of address from 15 Broad St. to 50 Broad St., New York City.

Frederick J. Seibert has been appointed manager for the Standard Metals Company, at Reno, Nevada.

H. L. Tedrow, of Los Angeles, has become foreman for the El Arco Mines Co., at Copala, Sinaloa, Mexico.

J. H. Stovel is now the manager of the mining department of the E. J. Longyear Co., of Minneapolis, Minnesota.

G. M. Colvocoresses, general manager for the Consolidated Arizona Smelting Co., was in San Francisco last week.

S. M. Soupcoff, mining engineer to the A. S. & R. Co. at Salt Lake City, was here this week on his way to Royston, Nevada.

George A. Denny, now in London, is consulting engineer to the Kirkland Lake Proprietary company, operating in Ontario.

Leslie S. Breckon, on his return from Cerro de Pasco, has been engaged as superintendent for the Consolidated Mascot Mines Co., at Hailey, Idaho.

John T. Reid, of Lovelock, Nevada, was a recent visitor in San Francisco; he is now on his way to New York City, where he expects to remain for several weeks.

R. M. Murray has been appointed assistant general manager for the Mount Lyell Mining & Railway Co., Tasmania. **Fred Jakin** has been made mine superintendent.

P. B. Lord, formerly mine superintendent for the Phelps Dodge Corporation at Morenci, is now assistant superintendent of the Santa Barbara plant of the A. S. & R. Co. in Chihuahua.

F. R. Hockey, superintendent of the Broken Hill Proprietary Co.'s mine, has returned to New South Wales after a tour of inspection of the iron mines of Great Britain, Scandinavia, Germany, France, and the United States.

Obituary

Edmund A. Thornton, assistant superintendent of mines for the Ray Consolidated Copper Co. at Ray, Arizona, died at Stoneham, Massachusetts, on January 9, after an illness of six months. He was 40 years of age and had been connected with the Ray Consolidated for 10 years. He is survived by his wife and one child.

R. W. Thompson, resident provincial mining engineer for No. 3, or the Central Mineral Survey District, died at Kamloops, British Columbia, on January 6. He was born at Guelph in 1865, graduated at Toronto University, and for a time was a member of the science faculty of that University. In 1895 he emigrated to South Africa, where he pursued his profession for 15 years. He returned to Canada in 1910, and engaged in mining in the north-western part of British Columbia; five years ago he was given the appointment of resident engineer, which he held until his death.

THE METAL MARKET

METAL PRICES

San Francisco, January 17

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6.25— 8.25
Copper, electrolytic, cents per pound	14.75—15.25
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$105
Platinum, 10% iridium, per ounce	$115
Zinc, slab, cents per pound	6.75— 7.75
Zinc-dust, cents per pound	9.50—10.00

EASTERN METAL MARKET

(By wire from New York)

January 16.—Copper is quiet and steady. Lead is unchanged and firm. Zinc is dull and easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Jan.	10	66.37½	35.50	Dec.	5	67.27	37.35
"	11	66.00	35.37½	"	12	65.46	35.44
"	12	65.75	35.12½	"	19	66.08	35.60
"	13	66.25	35.37½	"	26	65.50	35.25
"	14	66.12½	35.37½	Jan.	2	64.82	34.90
"	11 Sunday			"	9	64.90	34.83
"	16	65.87½	35.12½	"	16	66.06	35.31

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	[illegible]
Feb.	101.12	131.27	59.55	Aug	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	68.24
June	110.50	90.84	58.51	Dec.	131.92	64.78	65.76

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Jan.	10	13.62½	Dec.	5	13.39
"	11	13.62½	"	12	13.46
"	12	13.62½	"	19	13.58
"	13	13.62½	"	26	13.62
"	14	13.62½	Jan.	2	13.62
"	15 Sunday		"	9	13.56
"	16	13.62½	"	16	13.62

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	13.54

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Jan.	10	4.70	Dec.	5	4.70
"	11	4.70	"	12	4.70
"	12	4.70	"	19	4.70
"	13	4.70	"	26	4.70
"	14	4.70	Jan.	2	4.70
"	15 Sunday		"	9	4.70
"	16	4.70	"	16	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	4.70

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	32.49

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Jan.	10	5.12½	Dec.	5	5.23
"	11	5.12½	"	12	5.31
"	12	5.10	"	19	5.19
"	13	5.10	"	26	5.23
"	14	5.10	Jan.	2	5.17
"	15 Sunday		"	9	5.16
"	16	5.12½	"	16	5.11

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	5.24

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Dec.	20	52.00	Jan.	3	50.00
"	27	48.00	"	10	50.00
			"	17	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	40.40
June	94.40	85.00	49.50	Dec.	95.00	52.50	49.50

JAMES S. DOUGLAS ON FREIGHT-RATES FOR COPPER

The following statement was made to the Chamber of Commerce of Los Angeles on January 9 by James S. Douglas of the U. V. X. Copper Mining Co. of Jerome, Arizona.

"If the United States of America has a serious regard for the revival of business and for the future of her mining and industrial activities, a complete readjustment of freight-rates must be made at once. At present we are entitled to a $5 rate on unrefined copper from Arizona to Los Angeles harbor, and we are going after it if we have to carry the controversy to Washington. Before the War the rate to the Eastern seaboard on copper was $12.50 per ton. Today it is $16.50 with copper at the bedrock price of 13c. per pound. The shutting down of many mines in Arizona with the post-war slump has brought that industry to a turning point dependent upon a fair freight-rate to the Pacific coast, and unless that rate is established the return to normal of the mining industry there will be retarded indefinitely. At normal 40,000 tons of copper per month was shipped to the Atlantic coast from Arizona, which at today's low price represents a valuation of $124,800,000 per year. We propose to turn the bulk of that output through Los Angeles harbor, which perforce will mean the establishment of a great electrolytic refinery adjacent to this port.

"The logic and innumerable reasons for this turning of shipments to the west coast with a haul of 570 miles, compared with 3000 miles to the Atlantic seaboard, are indisputable. For years this colossal wastage of motive-power, man-power, and time has been tolerated, but today the tide has turned.

"Think of it, the Pacific Ocean comes within a few miles of washing the soil of the State of Arizona, and yet virtually the entire copper tonnage of that State goes 3000 miles by rail through the heaviest congestion of traffic to get to the Atlantic seaboard for refining. Now is the time for a refinery at the port of Los Angeles, and I may say that the very future of the copper industry of the West depends upon it, but the enviable opportunity is entirely controlled by the freight-rate situation.

"Now to prove that a $5 rate is entirely reasonable, consider these figures: The rate from Salt Lake City to San Francisco on this commodity is $6.50 and that distance is 200 miles longer than from Clarksdale, Arizona, to Los Angeles harbor. The rate yields the railroad 7.1 mills per ton-mile. A $5 rate from Clarksdale to Los Angeles harbor would yield the Santa Fe 8.9 mills per ton-mile. I say again, we are entitled to it and are going after it. We also will ask a $4 rate for export business.

"We expect to open up the United Verde Extension mine within 40 days on a scheduled output of 1500 tons per month and to employ 500 men. And we want our entire shipment to come to Los Angeles. The establishment of a refinery here would open up no end of manufactories where copper and brass are used, such as wire- and sheet-mills, and plants for making electrical appliances and storage-batteries, and numerous other lines of business subsidiary to the copper industry. The real stumbling-block is the fear that all railroads have of steamer competition out of your harbor. But I ask you, what was the Panama Canal built for, at its tremendous expense to the Government, if it is not to be used? Individual endeavor and use of our resources are the things that will bring the United States back to normal prosperity."

MONEY AND EXCHANGE

Foreign quotations on January 17 are as follows:

Sterling, dollars:	Cable	4.22¾
	Demand	4.23¼
Franc, cents:	Cable	8.21
	Demand	8.23
Lira, cents:	Demand	4.38
Mark, cent:		0.54

Eastern Metal Market

New York, January 11.

There scarcely has been time for any of the markets to get under way after the close of the year. They are all quiet; some are strong as to prices, others are easy.

Buying of copper is moderate and prices are steady to firm.

The tin market is dull and prices have eased slightly.

A good demand for lead prevails at firm prices.

The zinc market is the weakest, demand being confined to small lots at easing quotations.

Antimony is nominally unchanged.

IRON AND STEEL

Little activity was expected from the first half of January, with inventories uncompleted, and the quietness in iron and steel in the past ten days is not disappointing. Operations thus far have been slightly less than the average for December, the Steel Corporation's proportion now being 46 or 47%, against 49% last month, while the independent companies are today about 28%, after averaging 31% last month.

The December steel output of 1,427,000 tons of ingots by 30 companies reporting—a falling off of 233,000 tons from November—indicates that the country produced about 19,300,000 tons of ingots in 1921.

In casting up the prospects for blast-furnaces and mills, in looking toward the active season, manufacturers recognize that much hinges on the extent to which freight-rates and coal-mining and building labor are brought into line with the drastic deflation in steel. The possibility of a strike of miners of bituminous coal in April and the check it would put on iron and steel production are also regarded as factors of uncertainty.

COPPER

The situation is somewhat mixed in the absence of any heavy demand. Some electrolytic producers are out of the market entirely or are quoting no less than 14c., delivered, or 13.75c., refinery or New York, while others have a minimum of 13.87½c., delivered, or 13.62½c., New York. Efforts to confine sales or offerings to 13.75c., delivered, or 13.50c., refinery, have not been successful, although reports from consumers state that metal is obtainable at these levels. It is possible that some small producers or dealers are sellers of limited amounts at this concession of about ⅛c. below the major market. Sales have been moderate in a quiet market, but the position of most of the large producers is 'comfortable'. Inquiries, actual and prospective, give assurance of a good market in the coming weeks and the tone of the market is optimistic and technically and statistically sound. Export business is quiet. Quotations for January and first quarter are 13.62½c., New York or refinery, and 13.87½c., delivered, for electrolytic.

Exports of refined copper to December 1, 1921, were 537,592,659 lb. of which Germany took 202,191,469 lb. or about 40%. France was next, taking 89,924,618 lb., and the United Kingdom and Japan next with 61,158,053 lb. and 47,410,544 lb., respectively. Germany's purchases were larger than that of the three other countries combined.

TIN

The market for Straits tin has been quiet to dull thus far this year. Consumers have shown little interest and dealers have not been active. On the New York Metal Exchange on Thursday, January 5, a sale of 25 tons of Straits tin, January-February shipment, was made at 32c. and there were recorded also sales by importers at 32.50c. On December 31 the total visible supply was put at 25,220 tons, including Straits, Banca, and Billiton. The quotation for spot Straits tin in New York yesterday was 32.12½c. as compared with 32.75c. a week ago. The London market yesterday was from £3 to £4 per ton below quotations a week ago, with spot standard at £165 5s., future standard at £167, and spot Straits at £166 10s. per ton. Arrivals thus far in January have been 1580 tons with 6200 tons reported afloat.

LEAD

Demand for lead continues about equal to output and the position of most producers is strong, some having sold all, or a large part, of their January production in December and the past week. Some independents have made sales to Eastern points at 4.75c., delivered. The leading interest continues to maintain its quotation at 4.70c., New York and St. Louis, while independents continue to quote 4.40c., St. Louis, and 4.70 to 4.75c., New York or Eastern points.

ZINC

The market is dull and weaker. Prime Western for early delivery is quoted at 4.75 to 4.80c., St. Louis, or 5.10 to 5.15c., New York, at which some sales of carload and small lots are reported. There is some interest in February and March delivery, but producers are generally unwilling to sell for these positions at present levels and are confining sales to regular customers who for the most part ask for small consignments only. The market hinges on developments in the steel industry and on demand for galvanized sheets, which at present is light. There is a belief expressed that export demand will develop in the not distant future.

ANTIMONY

The market is dull and uninteresting at unchanged nominal quotations of 4.50c. per pound, New York, duty paid, which could probably be shaded.

ALUMINUM

Conditions are unchanged with wholesale lots of virgin metal quoted by the leading interest at 19.10c. per pound in 15-ton lots, f.o.b. plant, or 19c. for 50-ton. The same grade from importers is quoted at 17 to 18c., New York, duty paid.

ORES

Tungsten: Outside of inquiries from Europe for Chinese ore there is little change and prices continue nominal at $2 per unit and higher, depending on the grade, etc.

Molybdenum: Quotations are unchanged at 45 to 50c. per pound of MoS_2 in regular concentrates. One seller reports the sale of a small lot of 85% concentrate at 48c. per unit, f.o.b. New York.

Manganese: The market continues entirely stagnant. Stocks in consumers' hands are probably still heavy. Quotations are nominal at 20c. per unit for high-grade foreign ore, c.i.f. Atlantic ports.

Chrome: Nominal quotations rule of $20 to $28 per net ton, f.o.b. Atlantic ports, but there is little demand. One seller reports occasional demand for carload lots for spot delivery.

FERRO-ALLOYS

Ferro-manganese: Sales of carload and small lots are recorded, some being made by British sellers at $58.35, seaboard, and others by the Steel Corporation on a basis of $60, Pittsburgh. Consumers in general, although inquiring now and then for 100 to 200 tons, purchase only small lots for immediate needs.

Spiegeleisen: This market is more active and sales aggregating 250 tons have been made at $26, furnace, for the 20% alloy and at around $25 for the lower grades, sales including various analyses.

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T. A. RICKARD, ... Editor

THE article on 'Accidents in Metal Mines' that appears in this issue has a semi-official character because the author of it, Mr. Horace F. Lunt, is Commissioner of Mines to the State of Colorado. Mr. Lunt, moreover, is a mining engineer of experience, so that his discussion of this important subject is sure to be useful.

MONEY loaned by the United States to foreign countries during 1921 amounted to over $500,000,000. This indicates that the money-market of the world has shifted, since the War, from London to New York, for foreign-government loans arranged in America during the period under review were nearly six times greater than those raised in England. Germany has not borrowed; the purchasing power of the mark is lower than it was this time last year, whereas that of almost every other national currency has appreciated.

BELINGWEE Gold Reefs Ltd. and Arizona Consolidated Copper Mines Ltd. are names that suggest our South-West obviously and South Africa less obviously; as a matter of fact, they are two puling wild-cats, one near Bulawayo, in Rhodesia, and the other near Clifton, in Arizona. Why they should consolidate is not obvious, for, as 'The Capitalist' remarks, "the only thing to be said in favor of the scheme is that it will make one company instead of two in which incautious members of the public may be tempted to risk their money". It looks as if it were merely a new shuffle of the cards for despoiling the unwary.

IN our issue of November 12 we published part of the correspondence between the chairman of the Russo-Asiatic Corporation, a British mining company, and the representative of the Russian government. This showed that the mining company found itself unable to resume operations on its properties in western Siberia. Now comes the news that the company's agent at Moscow has been informed officially that the Soviet government desires to renew negotiations for the return of the properties to their rightful owners and to arrange for a resumption of productive industry. The Bolshevists appear to be prepared to make a complete surrender of their fantastic notions of socialism and to recognize the principles of honesty and fair dealing that underlie all profitable business. We hope that the negotiations will end satisfactorily, for if they do they will prepare the way for the resumption of work by other companies owning mines in Russia.

CHRISTIAN SCIENCE, either as a religion or as a science, makes no appeal to us, except as a study in pathology, but the newspaper published by the Christian Science church does interest us greatly because it is a first-rate publication. Therefore we regret to see that its management is involved in a bitter feud with the board of directors of the church that Mrs. Eddy founded. The 'Christian Science Monitor' is a remarkable newspaper in that it provides daily an enormous amount of trustworthy and well-prepared reading-matter. It is not a work of genius, but it is the excellent product of a group of earnest and capable journalists. It is remarkable in being non-partisan in politics, and even its religious ties are not made unpleasantly evident. We envy Boston the 'Christian Science Monitor' more than we do its Mayor, its Commonwealth Avenue, or its Brown Bread.

RECOGNITION of the Obregon government has been delayed much longer than had been wished by those who hope to see the two North American republics on good terms with each other. A significant step, and one of good augury, is the withdrawal of American troops from the border. The garrison at Yuma, Arizona, is to be transferred and all the Ninth Corps has been ordered to the Presidio, at San Francisco. Thus for the first time in fifteen years there are no United States soldiers on the Mexican border. This is a compliment that President Obregon's government well deserves, for he has established order and restored industry where for ten years the red hand of revolution was paramount. Our northern border has had no troops or fortifications for a hundred years to guard it from our Canadian neighbors and friends. The day is coming, let us hope, when similar security will be felt as we look across the Rio Grande.

JAMES BRYCE was a great man, a wise and kindly man, a co-operative and helpful man. No title could add distinction to one already so well known and so beloved among the English-speaking peoples. In death he doffs his title and is again the unpretentious old Scottish philosopher and statesman, whose books on 'The American Commonwealth' and 'Modern Democracies' have taught both old and young the essential principles upon which representative government may hope to thrive. His books are good in their way, but the man himself was bigger than his books. His greatest service to humanity was to bring the English-speaking peoples together, to interpret the parent country to her independent children, to expound the ideals that make us one. It was a service not only to the United States and to "the community of nations known as the British Commonwealth", it was a service to humanity, for if the English-speaking peoples cannot refrain from quarreling, if the sinister shadow of war is ever to darken their horizon, there is no hope for this battle-scarred world. James Bryce was a prophet honored in his own country and in others too; he was a seer in his generation and a friend of all mankind.

AN odd tilt with Dame Fortune is the recent purchase of bonds of the Cerro de Pasco Copper Corporation at 116 on the day that a part of the issue was called at 105 and interest. In January of this year the company floated $8,000,000 in 8% bonds to mature in January 1931, at the same time undertaking to appropriate $840,000 annually for a sinking fund to redeem the bonds at 105 and accrued interest. Pursuant to this provision the company called $140,000 early this month. The selection of the particular bonds to be redeemed was made by lot, so that one of the purchasers at 116 might have been unfortunate enough to have his bonds taken away from him at an outright loss of 11 points, although the odds were 49 to 1 in his favor. The explanation for the high quotation on the Cerro de Pasco bonds is the fact that they are convertible at any time before maturity for stock at $33.33 per share. The lowest level ever reached was $27 in August 1921, whereas in 1919 the shares sold for $67.50. The current price is around $35, but investors show unmistakable confidence in the future of the copper-mining industry, as well as of the Cerro de Pasco mines themselves, when they bid 116 for the bonds.

TWENTY-FIVE hundred dinner-pails in Butte are full this week that have been empty for nearly a year. Each day twenty-five hundred miners are climbing Anaconda hill who for nearly a year have had no regular employment. At the Black Rock mine of the Butte & Superior company, and at the Stewart, Mountain View, Leonard, and Badger States mines of the Anaconda Copper company, whistles are blowing that have been silent for nearly a year. The cages that have either been idle or that have carried only a lonely shaftman or timber-man are loaded with contented miners. Stockholders whose dividends have been discontinued may be hopeful; machinery-salesmen whose business has been dull may be cheerful; even publishers of technical journals whose welfare depends on the prosperity of the mining industry may enjoy a feeling of selfish satisfaction. But these satisfactions are trifling compared with the deep joy that pervades the little homes of these twenty-five hundred workers whose sacrifices and privations only they themselves and their fellow miners in Butte and the other idle mining districts can appreciate. May the time come soon when tens of thousands of men will go back to work, and when each wife or mother will have the pleasant duty of filling a daily dinner-pail.

DISCUSSION this week starts with an earnest contribution on the important subject of 'Research', by Mr. Frank H. Probert, Professor of Mining in the University of California. Our friend Mr. F. H. Mason shows a little irritation in his response to Mr. T. T. Read's letter, but the result is satisfactory to our readers in giving them an interesting disputation. Mr. Paul T. Bruhl writes from Honduras to record the results of his experiments in the use of varying proportions of lime in cyanidation. These technical data are most welcome. A contentious subject—the proposed adoption of the metric system—is discussed by Mr. Sterling B. Talmage of Salt Lake City. He scores a point. Mr. North of Berkeley protests against the sentiments expressed by Mr. Watson of Luning. Another plea for the prospector is made, this time by Mr. Frank P. Davis, of Fairview, New Mexico. He suggests the establishment of a Home for Prospectors, to be endowed by the funds obtained from the sale of licenses to the seekers of ore. Another letter in behalf of the prospector comes from Mr. J. T. Jones, of Mokelumne Hill. He objects to the incidence of forestry regulations as embodied in the Timber and Stone Act. Evidently the prospector as a class is not inarticulate, and we are glad that this is so, for the services of the prospector are essential to the expansion of mining.

THE old question of abusing authority to levy assessments on mining shares is agitating some of our friends in Nevada who fear, with reason, that meritorious enterprises will suffer as a result of some of the financing that is being done at the present time. It is true much ore has been found and many mines have been made that never would have been exploited except for the assessable-stock method of financing. No blanket verdict can be brought against the procedure. On the other hand it undoubtedly offers added opportunity for unscrupulous promoters to exploit the public in the most unjustifiable fashion, still within the sanction of the law. Their plan is simple. Shares are sold at 10 or 15 cents, for example, to unsophisticated purchasers, generally from the East, on the strength of glowing promises of early dividends. Instead there come assessments of a cent or two per share. Some of the innocent stockholders may pay the first and perhaps the second, but sooner or later many of the payments become delinquent and the promoters 'buy in' the shares for the amount of the assessment. Then they are sold again to different victims and the process of 'freezing out' by assessment is repeated. Sometimes the promoters have faith in the merit of their property; more often their faith is about as real as the ore that they are always 'finding' but never shipping. The suggestion is made that the officials of the stock-exchanges on which the shares are listed compel those in control of the companies to issue periodically complete financial statements showing the disposition of the funds already obtained, and that these statements be made accessible to the public. Perhaps we are pessimistic; certainly we are dubious. The people who buy such shares are not likely to take the trouble to investigate before they buy. The strange thing is that many of them are substantial citizens, who in their regular business exercise the utmost care and judgment. When mining is concerned they lose their heads completely; they are prepared to 'kiss their money goodbye'. And it is this kind of money that keeps the promoters in business. The only remedy is to teach people of this class to exercise the same discretion in mining that they would in any other kind of speculation. Ordinary caution would tell them not to invest in an enterprise of which they know next to nothing, and a financial statement such as is suggested would afford little additional light. Purchasers of shares can not avoid the risk inherent in opening new mining ground; but they can assure themselves a game in which the cards are not already stacked against them.

The Open Door in China

The proposals made recently by Secretary Hughes, that no nation should be allowed to maintain spheres of influence in China and that no monopolistic or preferential concessions should be granted by the Chinese government to any nation, indicate a proper conception of the principles of equity. At the present stage of development the Chinese are a susceptible folk, and the open-door policy is the only one that is fair to all; however, there are, as a philosopher once remarked, many ways of killing a cat besides choking it with butter; and the story of the placing of the contracts for the material needed in the new Shanghai mint is not an edifying one. From a number of sources we learn that the facts are as follows: For several years the establishment of a Chinese mint at Shanghai has been advocated by British interests in that part of the world. Strong representations were made to the Chinese government that the sycee (or silver ingot form used as a medium of exchange) be abolished, and that a uniform currency of dollars and smaller coins be established throughout the country. The suggestion ultimately was acted upon by the authorities; the Chinese Mint Commission invited definite suggestions, whereupon the necessary information was supplied. At this stage, in November 1920, it was obvious that the business was to be carried through equitably; no concession was to be made or favoritism shown. The Commission called for tenders on a plant to produce 400,000 silver dollars, or an alternative output of smaller coins, per 10-hour day; and these were submitted by a number of Japanese, Chinese, American, Dutch, and British firms. The British, who had done so much to initiate the movement, asked no favors and expected no preferential treatment; it was naturally anticipated that the Chinese Mint Commission would award the contract to the firm submitting the best tender, irrespective of nationality. At this stage, however, and to the amazement of those who had gone to the expense of tendering according to the original specifications, a mint expert was 'appointed' by the Chinese government, and he happened to be an American citizen. The immediate result was that the various firms who had tendered were supplied with a new set of specifications, each item of which included a special product of American manufacture. Further specifications, signed by the American mint expert, were issued from time to time, being illustrated by representations of special American products as an indication of what was required. The nationals of other countries did not have adequate time to prepare the new tenders, which, it was obvious, would have received no consideration; and little surprise was evinced in any quarter when the contracts were awarded to American firms. The incident aroused much disgust among competing nationals in Shanghai, and the Government was blamed as having shown a lack of ordinary commercial decency. However, the Chinese are extremely sensitive to outside influences; hence the need for the exercise of an impartiality that will ensure equal opportunity for all nationals who are interested in the development of that country as well as in the legitimate overseas expansion of their own industries.

The Risks of Mining

A marked copy of the 'Salt Lake Tribune' containing an article on 'The Causes of Failure in Mining' has been sent to us. The article is by Mr. Henry M. Adkinson, and we have read it with interest, because, like other members of the mining profession, we have sundry notions on the causes of such failure. First, Mr. Adkinson finds that unscrupulous persons are aided in obtaining money on false representations by reason of the fact that "only a very few interested investors are trained even superficially" in a "special knowledge of geology". Hence, he says, there exists "a rather widespread feeling that mining is a highly speculative business". Here at once is matter for disputation. Our own observations would indicate that a smattering of geologic knowledge does not help the so-called investors so much as is supposed; on the contrary, it proves usually to be that little knowledge that is proverbially dangerous. It is well enough for a client to know enough of the A B C of geology to be able to understand the report on a mine or to follow the advice of an engineer, but when the client intrudes his own half-baked ideas on the subject the result may be lamentable. The greater harm to the business, however, is the supposition that mining is an investment, not a speculation. That is an old blunder, and one against which we have animadverted many times. Mining may not be "dangerous", but certainly it is risky; indeed it is the element of risk that makes it so attractive to the genuine adventurer, using the word in the proper sense of one who embarks on a legitimate venture. Without risk there would be no prospect of a large gain; and it is the possibility of a gain large in proportion to the money used that attracts the real miner. The sagacious man diminishes the risk as much as possible by careful investigation, and, more particularly, by taking the advice of an experienced and otherwise trustworthy specialist, a mining engineer; but he never imagines that he can avoid all the risk inherent in the search for ore. Mr. Adkinson says that "many of the speculative hazards of mining are either wholly eliminated, or reduced to a minimum, if the business is undertaken with the same sound business judgment and the same careful attention to ordinary business principles that the commercial fields with which most men are acquainted demand". To which one might say, "I get you, Steve", despite the syntactical obstructions. Certainly the losses incurred would be much smaller and the winnings would be much larger if the ordinary principles of successful business were not ignored so often; but the suggestion that all risk can be avoided is repeated, and to this we must demur again. All business involves some risk, of course, but in mining we have to deal not only with the natural depravity of man, particularly his proneness to do unto others as they would do unto him, and to "do it first"; we have not only the aberrancies of human nature and the trickeries of trade, such as are common to commerce, but the vagaries of ore deposition—the inevitable uncertainty as to the continuity of orebodies. This factor of uncertainty can be overcome by exploration and development, by drilling and cross-cutting, so that enough ore can be rendered measurable to serve as an assured reserve for several years. Then there is established what is commonly called—in prospectuses—"a manufacturing proposition", that is, an enterprise in which one can count on a steady profit because both the supply of raw material and the market for the finished product are assured. We do not belittle the splendor of such mines as have been so developed as to ensure a steady output for many years and thereby to postpone definitely one of the dangers to which mining is subject, namely, the depletion of the ore-reserves; but even to enterprises of so favorable a character it is a misuse of terms to apply such a phrase as "manufacturing proposition", because it is deceptive. A mine is a wasting asset; its resources are consumed without replenishment; the more ore one removes the less remains in the ground. A manufacturer once he is established can obtain his raw material from many sources; he is not self-contained in this respect, nor does he expect to be. As to the market for the miner's products, it may be said that in this regard he is no worse placed than others engaged in business, for recent events have proved how the prices of everything fluctuate between wide extremes. On the other hand, we do not hesitate to say that when the element of risk in a mining enterprise has been removed apparently, by the proof of enormous reserves and the assurance of a fixed price for the metallic product, it ceases to be a good mining venture for those not already participating in the venture, because usually the market valuation of the property by that time has reached a point where investment is unattractive—the rate of the return on the capital, plus allowance for redeeming that capital, is insufficient for a sound investment, whereas its attractiveness as a speculation has been lost by reason of the fact that most of the favorable possibilities, of expansion or enrichment, have been discounted, so that there remain chiefly the chances of disappointment. Of these there are plenty lying in wait for the man that believes there is no risk in a well-developed and well-managed mine. Besides the finding of blocks of poor ore and barren rock within the heart of the reserve, and of refractory elements in some of the ore, there are the usual mishaps of fire, flood, and strikes. Such troubles may come to any business, of course, but a fire underground or the irruption of an excessive flow of water are perils of a character unlike anything that may befall an enterprise established on the sunlit surface.

All this sounds anything but cheerful. Our purpose, however, is not to belittle the attractiveness of mining but to emphasize the fact that in the risk lies one of its chief attractions, if with the recognition of its inherent hazard there is maintained a reasonable amount of caution. Incompetent management and lack of capital have crippled many promising mining ventures, but the greatest losses that the public has sustained have been caused by the over-valuation of the richest and biggest mines on the supposition that no risk remained. The over-valuation of such mines as the Consolidated Virginia, the Contention, the Chrysolite, the Mollie Gibson, the Goldfield Consolidated, the Esperanza, the Mount Morgan, the Broken Hill Proprietary, the Lake View Consols, and the Waihi have hurt the public much more than have the misadventures of a hundred wild-cats. Most of the great bonanzas have been appraised on the share-market at three, four, or even ten times their real value, on an investment basis, that is, interest plus amortization. When a five-million-dollar property is valued at fifteen or twenty millions, as expressed by the stock quotation, it is evident that somebody loses ten or fifteen millions. What happens is that this amount of money is transferred from the pockets of the many to the coffers of the few. Part of the loss is due to greed, to the hope of becoming rich quickly, but most is due to the assumption that the element of risk does not exist in the operation of a proved bonanza. This is accepted to such an extent that its resources are supposed to be inexhaustible, as was believed by the victims of the Rand consolidations. As a matter of fact, the buying of stock in these phenomenal mines constituted a bad mining risk because the chances of a large gain had been fully discounted, and the speculator was in the position of one who backs a favorite when the betting will allow only odds so great that the gamble is a poor one, that is, there is little to be won in proportion to the amount that may be lost. In short, those who bought bonanza stocks thought they were investing, whereas they were gambling recklessly. As soon as the element of risk disappears from a mining venture, and the market has discounted the supposed fact, it is the part of wisdom to get out of it or to stay out of it. Mining is an adventure, a sane adventure; it is rarely an investment and it need not be a gamble. It is a reasonable speculation.

Research

The Editor:

Sir—To the Great War we attribute all the political, industrial, moral, and social ills that beset the peoples of the earth. Under the whip of war, with little but patriotic pride as an incentive, genius, initiative, resourcefulness, and other kindred latent qualities were developed over-night, and being efficiently organized they rendered irresistible the combined forces of the Allies. Research was the watchword in answer to the cry of alarm as new and unusual problems were forced upon us. Current practices had to be changed, substitutes devised for things then unprocurable, for intensive production regardless of cost was vital to success. Self was subordinated to country, *e pluribus unum*. So the War left us, and as the clouds lift we find it difficult to adjust ourselves to changed conditions; on every side we hear the watchword 'research' echoing back from many reflecting surfaces until it becomes almost a noise to our ears. In the true spirit of research let us ponder this pandemic.

An editorial in the 'Mining and Scientific Press' some months ago (May 21, 1921) pleads for research in modern institutions of learning, but suggests restriction of the field to those possessing the rare yet essential qualifications of seekers into the great abyss of undiscovered truth. These traits of genius are a priceless heritage to a select few. They may be developed in a small number, they are unattainable by the multitude, and yet in many scientific societies, educational institutions, and academic circles prolificacy in research is the yardstick by which professional standing is measured. The spirit of research, in my opinion, is blasted when mentality is conscripted into the cause.

Research is not peculiarly the prerogative of a professor nor is it a priceless gem cut, polished, and mounted in a setting of university libraries and laboratories. It may be conducted by private parties, government bureaus, or business organizations; its field comprises not only the sciences, arts, and letters, but the humanities. Everywhere there is need of investigation, and with increasing knowledge new projects will be born, dead issues revived. Admittedly a modern university, *per se*, is concerned with a balance between the discovery of truth and the transmission of learning, but in the editorial above referred to I infer that a deeper significance is given to the term 'university', one not restricted by campus walls or quadrangle, but that larger field where organized common-sense may operate to alleviate and ameliorate human needs and ills, to discover by synthesis and analysis the dormant forces and put to use for the benefit of mankind the resources of the earth. Research must be conducted not only into musty manuscripts, pestiferous pus, or elusive electrons, legitimate and attractive as these verdant fields are to those who can ruminate in them, but investigative work should have a utilitarian touch, that industry may give birth to industry, that natural forces may be marshalled and made servants to man, so that human progress, contentment, and enlightenment may result. Research may give us the flimsy gossamers, but it must weave these priceless threads into the warp and woof of industry. I do not belittle the enriching influences of scholarly search into abstract and abstruce realms of thought, which illuminates our path in following the obscure causes of advancing civilization. The engrossing enigma of the fourth dimension will in time be understood by others than Einstein, but in these troublous times we need substance, not shadow; food, not foibles. Better perhaps that our energies be directed to the great problem of human relationships, man to man, nation to nation, and strive for a solution of this world-wide condition of unrest and economic stagnation.

The great crises of our lives appeal first to our emotions, then to our intellect. Surely the nightmare of war has left us in a state of hysteria, and the last convulsive sobs are not yet. The youth of the land seeks solace in supper and dance; the laboring man has tasted of a luxury to which he is not accustomed; society consumes itself in riotous living. "Back to normal" is a good slogan to be sounded in schoolroom, church, home, and workshop. The word 'back' is a forward movement, anomalous as this may seem. Research in the field of human endeavor, the straightening of the path of life, is of infinitely greater importance at this time than the causation of cosmic cataclysm. Dallas Lore Sharp has recently said, "Not scribe but citizen, not author but voter, is the business of the school, the true end of its course of study".*

The symptoms of the mental, moral, and economic disease with which the world is afflicted are so woefully apparent that further diagnosis without palliative prescription may make the condition chronic: nor can we remedy by drastic action of excision, by mental therapeutics, or the rest cure. Patient and practitioner must collaborate in order to effect a cure. It is socially and economically unsound to anticipate a return to the conditions of 1914, for the despotism of capital and the arrogance of labor are of the dead past. One of the greatest problems confronting us is how best to effect a reconciliation of these warring elements, by what means can the wage-earner be brought to understand the risks and problems of the payer of wages, and whereby can the capitalistic class be made sympathetically mindful of the legitimate aspirations of those on whose efforts output depends.

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*'The Atlantic Monthly', July 1921.

The field of humanics is an inviting one to the research worker, and in persistent conscientious search, new relationships may be established even though startling discovery be not made. Secretary Hoover, of the Department of Commerce, with the broad constructive vision that characterizes him, is promoting by preachment and practice, by conference and council, a policy of investigation which cannot fail. Judge Gary in his statement to the stockholders last annual meeting of the U. S. Steel Corporation subjected the soul of his corporation to the light of day with such frankness that even the most obdurate must see in his words an earnest unreserved desire to take council with all classes, but, says he, "Where the interests of the general public and the nation clash with private interests the latter must be subjugated, the obligations are reciprocal, the management of a corporation must have constantly and uppermost in mind the rights and interests of the general public not only as determined by the law of the land, but as ascertainable from public sentiment, when clearly defined". He advocates publicity, regulation, and reasonable control through government agency: comprehensive practical legislation, binding to capital and labor alike.

John D. Rockefeller, Jr., in an address at Atlantic City, before the Chambers of Commerce of the United States, in 1918, presented an industrial creed, part of which I quote:

"I believe that labor and capital are partners, not enemies; that their interests are common interests, not opposed, and that neither can attain the fullest measure of prosperity at the expense of the other, but only in association with the other. I believe that the purpose of industry is quite as much to advance social well-being as material well-being and that in the pursuit of that purpose the interests of the community should be carefully considered, the well-being of the employees as respects living and working conditions should be fully guarded, management should be adequately recognized, and capital should be justly compensated, and that failure in any of these particulars means loss to all four. I believe that the application of right principles never fails to effect right relations; that the letter killeth and the spirit maketh alive; that forms are wholly secondary while attitude and spirit are all important, and that only as the parties in industry are animated by the spirit of fair play, justice to all, and brotherhood, will any plans which they may mutually work out succeed."

These reflections of thinking minds are not platitudinous. Expressed thought has anticipated constructive action, and material progress is being made. Withal the greatest forces of industry are the unseen forces, constant and certain in their action. Integrity is a real factor; intelligence cannot be seen, but no one questions its influence; and the greatest of all is good-will. The spirit of the worker is either industry's greatest asset or its greatest liability; this statement is irrefutable. To engender a right spirit is the solemn responsibility of the man who handles men. High wages, short shifts, and even good living conditions do not guarantee industrial peace. Good-will is a human attribute which cannot be begotten of material forces; human contact alone creates it. Here is a fallow field inviting to all; let us press deep into its yielding surface the plowshare of peace; let us sow the seeds of research and garner an abundant harvest.

Returning to the narrow confines of the college campus, where perhaps the cry of research is heard the loudest, is there not here a neglected but prodigiously potential field for research other than that of parchment, test-tube, or microscope? Here year after year thousands of students foregather, and for what purpose? To be filled with dogma and doctrine, stuffed with a heterogeneous hodge-podge of text-book learning which on being equated into units of a set curriculum may equal a degree! Yes and No! A university fails utterly if it disregards or belittles its obligation to take the plastic clay of youth and mold it into the form of sturdy, chivalrous manhood and worthy citizens. Dean Frederick Schutz Jones of Yale made this significant remark a year ago, "There was a time when I thought we must teach in college first and foremost the learning of books. In these days I would bend every effort to the making of good citizens, and by a good citizen, I think I mean a man who is master of himself, earns his own living, and as far as possible in doing it is of benefit to his fellow men". The doleful note of wailing jeremiad is heard in every college community, but few indeed are they who heed it.

Many people have a grievously wrong idea that a university is an academic workshop turning out a finished product branded by a parchment as a scholar. A university is but a step from the kindergarten. It cares for children of larger growth, immature, susceptible to influences for good or ill, striving for mental as well as bodily growth and development, responsive, enthusiastic, human. Shall we gorge the brain and starve the soul of such as these?

The spirit of scholarship must be fostered, alertness and an enquiring habit should be stimulated, and every inducement and encouragement given to those gifted with a brilliant intellect; but a university has other duties to perform, it must care for the moral, as well as the mental welfare of those whom it admits. Our State institutions do not discriminate against sex, creed, or color: rich and poor are invited, any and all who can meet certain requirements of somewhat loosely enforced rules of scholastic standing. Such a motley group needs moral direction, ideals of right and righteous living must be a part of curriculum, love of home, loyalty to State and country, noble manhood and sweet womanhood, surely these most precious things may be taught with more lasting benefit to the student than many of the decadent philosophies of ancient and modern times. But in order to teach these things we must know the material with which we have to deal; research into human hearts, minds, and motifs is necessary. It is a blessed field in which to labor, requiring no costly physical equipment of laboratory or library; the problem never palls, intricate and seemingly impossible as some of the complications are at times; tangible results are quickly obtainable and the reward of effort is certain. The appreciation of the work done may seem to be written in sand, which the first tide of adversity or success obliterates, but more often the reactions are graven in the hearts of men and endure to the end.

Frank H. Probert.

University of California, January 5.

Wetting and Amalgamation

The Editor:

Sir—In your issue of December 31, T. T. Read attempts to wax facetious with regard to my letter on wetting and amalgamation, which appeared in your issue of December 3. Had I been fortunate enough to have read Mr. Read's paper on amalgamation of gold ores, which he mentions as having appeared in the Transactions of the A. I. M. E. for 1907, I might have felt that the last word had been said on the subject, and not have made the experiment I described; but I did not see his paper, and as it appeared several years after my experiment it would have been too late to direct my efforts into more profitable channels, even if I had seen it. I had read a good many exhaustive works on the subject of amalgamation that pre-dated Mr. Read's paper, but they did not deter me from making the experiment.

Mr. Read suggests that, as I did not publish the result, probably I made the experiment to amuse myself. Using the word 'amuse' in the sense of 'to occupy pleasingly', he is right; unless I am much mistaken a great deal of research is done for that purpose, for to search for truth by means of experiments is a pleasureful occupation. As a matter of fact, however, the result of the experiment was embodied in a paper on gold solvents that I read before the Mining Society of Nova Scotia, and which duly appeared in its transactions. I was well aware at the time I made the experiment that I was traversing ground that already had been trodden, but I was under the impression that I was doing it in a different way, and Mr. Read, with his, perhaps, fuller theoretical knowledge of the subject, offers no evidence to the contrary. When writing the letter on wetting and amalgamation, as it bore on the subject, I thought it would be interesting to give an account of the experiment, and in doing so I distinctly stated that I was writing from memory. Under such conditions, it hardly was to be expected that I should include a bibliography of what previously had been done. I had not the necessary data at hand. I stated in my letter, however, that it was well known that gold was more soluble in hot than in cold mercury, and I thought that statement would have precluded anyone with ready perception from thinking I imagined I had reached an original conclusion.

Mr. Read appears to agree with Andrew Carnegie that much time and money is wasted because investigators fail to find out what others have done. Perhaps it is; but can it always be taken for granted that what has been done has necessarily been done absolutely accurately? Huxley took an opposite view to Carnegie, and insisted on the importance of first-hand knowledge from experiments. He boasted that he never stated anything for a fact in his biological lectures that he had not verified by his own experiments. There is so much to be done in these days that this no longer is always possible; still, that Huxley in the main was right has been proved a thousand times. For example, had Rayleigh been content to accept as accurate the previous determinations of the density of nitrogen, argon would not have been discovered. The frequent periodic revision in the atomic weights of the elements, made necessary by the errors of experimenters, strongly supports Huxley's contention. But why go on? Of the finding of examples there is no end. To my mind, the great difficulty in starting any new research is to know what to accept and what to verify, or disprove, as the case may be.

In conclusion, may I draw Mr. Read's attention to a little poem by Eden Phillpotts that appeared in a recent 'Scribner':

"I cursed the puddle when I found
Unseeing I had trod therein,
Forgetting the uneven ground,
Because my eyes
Were on the skies,
To glean their glory and to win
The sunset's trembling ecstacies.

"And then I marked the puddle's face,
When still and quiet grown again,
Was but concerned, as I, to trace
The wonder spread
Above its head,
And mark, and mirror, and contain
The gold and purple, rose and red.

"We seek our goals; we climb our ways
With hearts inspired by radiant thought,
And hate the luckless wight who stays
The upward stream
Of vision's beam;
Nor guess that we have roughly wrought
A like hiatus in his dream."

Victoria, B. C., January 4. F. H. Mason.

Lime in Cyanidation

The Editor:

Sir—In your issue of November 5 there is, in the section devoted to Discussion, an interesting contribution by Mr. Ernest Gayford. In some experiments I made a couple of years ago on the effect of varying amounts of lime on the extraction of gold I found that the larger amounts caused a decrease in the extraction of about 30%. This decrease I attributed to the interaction of calcium hydrate with some of the soluble salts in the mill-water. The addition of lime to the water resulted in the formation of a white gelatinous precipitate which was the cause of the trouble, for when it was removed by filtration prior to cyanidation the extraction was normal. I do not think that lime by itself causes re-precipitation of dissolved gold or silver; it probably retards their solution through inter-action with some soluble salt. This inter-action may produce a precipitate possessing reducing properties; or it may engender a soluble salt that is a precipitant of the precious metals. The observation that low alkalinity causes re-precipitation is of interest. I append the results obtained when different amounts of lime are added to a high-grade silver ore. In the tests enough powdered lime was mixed with the ore at the commencement of the experiment to neutralize the acidity which had previously been determined. A varying surplus ensured varying alkalinities during and at the end of the experiment. The lime used was 33.3% water-soluble and the tailing assays were corrected for the extra weight introduced by the insoluble portion of the added lime. The cyanide solution was made up with tap-water. The results show that different alkalinities have little effect on the extraction of silver and none whatsoever on that of gold:

Agitation for 70 hours. Dilution 4:1. Heads: Silver, 58.58 oz.; Gold, 0.055 oz.

	Before test		After test			Consumption	Tailing assays		Extraction	
Test No.	Total KCN %	Free KCN %	Total KCN %	Free KCN %	CaO %	per ton KCN lb.	silver oz.	gold oz.	silver %	gold %
1	0.440	0.440	0.310	0.310	0.042	10.4	4.60	0.00286	92.16	94.80
2	0.440	0.440	0.307	0.307	0.082	10.4	4.90	0.00286	91.65	94.80
3	0.440	0.440	0.300	0.300	0.105	11.2	4.75	0.00286	91.91	94.80
4	0.440	0.440	0.300	0.300	0.110	11.2	4.54	0.00286	92.26	94.80

PAUL T. BRUHL.

San Juancito, Honduras, December 6, 1921.

Metric Weights and Measures

The Editor:

Sir—The communication from H. W. Reed, in your issue of December 10, brings to my mind a conversation I had some years ago with a conservative Englishman, who insisted in all seriousness that the British monetary system was not only preferable to, but also simpler than, the American. To my somewhat breathless inquiry as to his reasons for so stating, he replied, "Well, when you tell me an amount in dollars and cents, I have to convert it into pounds, shillings, and pence before I know how much money it represents".

Mr. Reed's suggestion indicates a similar attitude. The trouble lies not in the metric terms, but in the fact that people have not been trained in their use. The term 'metric ton' has absolutely nothing to recommend it except a degree of usage; it is simply a lazy man's substitute for a conversion table—it merely helps one to remember that a tonneau might be defined as "about as much dirt as a one-ton truck should carry". If a man wants to be more definite than that, he must either think in kilogrammes, or consult his conversion-table.

The chemist has been trained already to use metric weights and volumes; and in laboratory work, the English units are never even considered, except possibly when presenting final results. But if Mr. Reed's suggestions are carried to their logical conclusion, we may expect to read in the most up-to-date work on analytical methods something like this:

"Take a metric quart of solution A, boil it down to a metric gill, add eleven thirty-seconds of a metric ounce of solid reagent B, run in solution C to the desired reaction from a burette graduated in hundredths of a metric half-pint, and is the value of the resulting precipitate is in excess of a metric six shillings and ninepence, the material may be considered as a commercial possibility."

An absurd comparison? Of course it is; but the absurdity differs only in degree and not in kind from the suggestion made by Mr. Reed. The remedy lies not in devising a hybrid system, or illegitimate cross between metric and English, inheriting the vices of both and the virtues of neither; it is a matter of educating people to think in metric terms. The advantage of metric weights and measures over the present English system is recognized to be fully as great as the corresponding advantage of the American monetary system over the English; but we have not yet been educated up to it. If, instead of the periodic agitation for a law making the use of the metric system compulsory, we could initiate one strong movement which would result in the teaching of the metric system in the public schools, along with the English system, I believe the relative advantages of the metric system would become so well known that within a few years the clumsy English units of measurement would naturally die of disuse. I know there is no laboratory chemist, trained to think in metric terms, who would voluntarily go back to the use of avoirdupois or apothecaries units in analytical work.

STERLING B. TALMAGE.

Salt Lake City, December 25, 1921.

Royston

The Editor:

Sir—Under the above heading in today's issue of the 'Press', Mr. Watson of Luning, Nevada, vents his spleen upon the whole tribe of mining engineers. It is a fortunate thing for the profession that such men as the correspondent are not in the ascendant in localities where capital is needed by prospectors to develop properties of merit. It is also fortunate for the mining industry. Such a spirit as evidenced by Mr. Watson would effectively quash the successful exploitation of any good mine and render improbable its ultimate development and the extraction of its values for the benefit of mankind. Money is needed to mine successfully, and is not forthcoming unless the facts of the case are set forth in an intelligible manner for the information of would-be investors.

An honest engineer is a pillar of the Republic.

ALFRED C. NORTH.

Berkeley, California, December 31, 1921.

The Prospector

The Editor:

Sir—There has been considerable discussion in the 'M. & S. P.' and other publications during the past year concerning the mining law and prospecting, some for the betterment and some for the worse. No good has come from any of it, only a lot of bitter feeling.

There is now being talked of, and being formulated, a plan for the betterment of those that follow the profession of prospecting by several prospectors in the West. The following is a rough outline of the plan.

An amendment to the present mining law: All prospectors (citizens of the United States) on the public domain to be compelled to take out annually, in advance, a license to prospect and locate; the fee to be $5. Any one whose name is used to locate shall pay the same fee.

The money thus derived to be put into a fund for the establishment and maintenance of a Prospectors Home (not a poor-house) on the order of the Soldiers Home, to be erected on the coast somewhere near San Diego or Los Angeles. This is to be a national institution; also a monthly pension of $15 shall be paid to the inmates. The Home is to be under the supervision of the Secretary of the Interior, who is to appoint a board of medical and practical men to run the same, the benefits of which are to be only for bona-fide prospectors who are down and out and some who need medical attendance. The fund obtained from sale of licenses to be open for donations from any one, to be used for the benefit of the Home. Most all trades, unions, and professions have some place to take care of their own, but the down and out prospector has none unless it is through charity and lots of red tape; so he gets in the poor-house or some other place. In your issue of April 23, 1921, you wrote an excellent article on 'Prospecting—Past and Future'; in it you ask the question what becomes of the prospector? You said that like the old hats and pins he just disappears to be replaced by new ones; but the answer to your question is that when down and out he can generally be found living in some cabin near some of his claims, probably at some old worked-out placer where he can eke out an existence by working and as a rule he is found dead in the cabin neglected by all in old age and sickness.

At the next session of Congress maybe a bill will be presented to amend the law as above outlined. This bill would pass without opposition; it would not cost the Government or the tax-payers as a whole anything; it would be self-sustaining—a small reward for the ones who are the primary cause of our great mineral developments and wealth. This fund would receive many donations to it every year, sufficient to run the Home in first-class shape and to enable the old down and out prospector to end his last few days in some comfort. All prospectors would donate to this fund when they had it (I will give $500); so would mine-owners and undoubtedly many of the large producing mining companies, who now have an age limit on employment. Retired mining men and many others who have been successful in the game would have a chance to do some good to those that were unsuccessful at the last.

Maybe the future won't be as bright as the present with us. This living in hopes and dying in despair is no joke, for 99% of us get the last in the long run.

FRANK P. DAVIS.

Fairview, New Mexico, January 1.

Plight of the Prospector

The Editor:

Sir—I have read many interesting articles in your paper in regard to our fast-disappearing prospector, who certainly does need some relief.

Along with many other difficult problems that the prospector has to contend with, is the law that is known as the Timber and Stone Act. So much depends on the report of the cruiser that is sent out to make an estimate of the amount of board-feet there is on a certain tract of land. Now the question is, does he know where this certain tract of land lies and can he find section-corners? In many cases, I doubt it.

As I understand the law, a separate estimate of each 40 acres must be given. The blueprint that the cruiser has to guide him is not sufficient. In fact, I have seen men in the field that were completely lost. In one instance I was called on for information. At that time I was doing some prospecting not far from the section-corner that was wanted. As I had worked over some of the lines in that district, I went with the cruiser to the section-corner wanted and was well paid for it. Here is where the prospector gets the worst of it. In the instance just mentioned there was very little of the 160 acres examined. There might have been one or several mining claims on this ground, and the cruiser would have known nothing of it.

Many mining claims that have considerable value are not patented. After the prospector does his annual work, places the same on record with the County Recorder, this ought to be sufficient, but under the present laws such is not the case. On several occasions I have known a prospector put to the trouble and expense of going to law to prove his rights after having possession of the ground for many years. The mineral right is supposed to have the preferred right over all others, but I fail to see where he gets it. The prospector has a hard time at the best, let alone fighting for it after he finds it.

Why not have the timber-man consult the County Surveyor and have the land properly described before a filing is made? How are we going to keep our gold reserve if the prospector is not allowed to dig for it?

J. T. JONES.

Mokelumne Hill, California, January 7.

Tungsten in Colorado

Conditions affecting the production of tungsten in Boulder county, Colorado, are outlined in a report just issued by the U. S. Bureau of Mines. The history of the tungsten industry in Boulder county illustrates how a valuable mineral may be overlooked because of ignorance of its nature or because of its being of no economic value at the time of its discovery. In 1870, Sam P. Conger discovered the famous Caribou silver mine in the western part of the county. The prospectors who flocked into the district soon became familiar with a heavy dark mineral, found as 'float', to which they gave various names, such as 'heavy iron', 'black iron', 'hematite', and 'barren silver'. In the early part of the year 1900, Conger's partner, W. H. Wanamaker, who had seen the tungsten ores found in the Dragoon mountains of Arizona, recognized this 'float' as an ore of tungsten. Conger and Wanamaker kept their discovery a secret and in August 1900 obtained a lease for the purpose of working the tungsten placers and developing veins. By the end of the year about 40 tons of high-grade ore had been taken out, but until the end of 1914 there was no development of importance.

By the middle of 1915 the war-time demand for high-speed tool-steel, of which tungsten is usually a component, became so great as to cause feverish activity among the owners of the known Boulder county deposits. In the tungsten localities the high prices brought about a boom similar to the excitements caused by important gold discoveries. Nederland, which had been a little village of a few dozen homes, became a bustling town of 3000 or more inhabitants. Optimism prevailed throughout the entire district, and fabulous prices were asked for properties that showed nothing more than a streak of tungsten ore in the bottom of a 10-ft. discovery shaft. Leases on old dumps and mill-tailing ponds were sought eagerly.

The price of tungsten rose to $75 per unit, and at least one lot is known to have been sold for $105 per unit. Such high prices caused the large users to import tungsten ores from South America, and later China, as these foreign ores could be laid down in this country very cheaply. As a result of these importations the market broke rapidly, and during the later part of 1916, 1917, and nearly all of 1918 it was fairly steady at about $25 per unit. The small demand, upon the signing of the Armistice, together with the large importations and stocks held by dealers, forced the price down so much that early in 1919 all of the Boulder county producers were forced to suspend operations. In consequence there has been a strong movement for placing a protective tariff on all imported tungsten ores and products; and it seems to be the general belief of the producers that some form of protection is necessary to the maintenance of the industry in this country.

The principal use of tungsten is in the manufacture of high-speed tool-steel, which, in addition to tungsten, contains chromium and vanadium. By the use of these wonderful alloy-steels one man now does as much work with one metal-cutting machine as could formerly be done by five men with five machines equipped with the carbon-steel tools formerly used. Under the standard adopted for testing tool-steels the ordinary carbon-steel failed at a speed of 15 ft. per minute, whereas a tungsten-steel tool withstood 90 ft. per minute, even when its edge became dull red in diffused daylight.

Besides the use of tungsten in steel, in which it is saving millions of dollars per annum in wages, it is saving other millions of dollars to consumers of electric light. A few years ago tungsten was regarded as unobtainable except as a brittle metal, but, by one of the most remarkable of the many investigations dealing with the application of science to industry, the pure metal, although melting at a temperature above 3100° C., is now being drawn into wire and molded into forms. More than a million feet per day of such wire is being drawn in this country for electric lamps. Incandescent lamps with tungsten filaments are now made that consume only about five-tenths of a watt per candle, against 3.5 watts per candle used by the carbon-filament lamp of ten years ago, so that now one may have for 15 cents as much electric light as he could get ten years ago for one dollar, and of much better quality.

Tungsten-alloys are used or have been suggested for many purposes, as tungsten can be alloyed with most metals. It alloys readily with nickel, cobalt, molybdenum, uranium, chromium, iron, manganese, vanadium, and titanium.

Some other uses of tungsten are in replacing platinum and platinum-iridium alloys for contact-points in spark-coils, voltage regulators, telegraph instruments, and other electrical devices; wrought tungsten targets for X-ray tubes; finely divided tungsten as catalytic agent in the production of ammonia from nitrogen and hydrogen; permanent magnets made by heating and quenching a steel containing 4 to 5% of tungsten and 0.5 to 0.7% of carbon; and in parts of gas-engines, such as valves.

The production of tungsten ores in the United States for 1916 was the largest ever made by any country in the world, the amount being 5923 tons, valued at $12,074,000. The development of milling practice in Boulder county, the ore-dressing methods in use, and the local manufacture of ferro-tungsten and tungstic oxide are described in Bulletin 187, 'Treatment of the Tungsten Ores of Boulder County, Colorado', by J. P. Bonardi and J. C. Williams, which may be obtained on application to the Director of the Bureau of Mines, Washington, D. C.

EXPERIMENTS have been undertaken to minimize the loss of metal in anodes used in precipitating copper in Chile. It was found that an alloy of 70% lead, 20% tin, and 10% thallium lost only 1.2 lb. per 100 lb. of copper precipitated. It was also found that, in general, alloys with high melting-points are more resistant to corrosion. The liquid subjected to electrolysis in the operations studied was a solution of copper sulphate containing nitric and hydrochloric acids.

Accidents in Metal Mines

By Horace F. Lunt

The scientific study of the cause and prevention of accidents in metal mining, as in other branches of industry, is comparatively new. Before the enactment of workmen's compensation laws the subject was generally given only casual attention or, too often, overlooked entirely; but the great catastrophes caused by explosions in coal mines showed in a forcible manner the necessity of safety measures, and of inspection to ensure that they were observed. Subsequently, it became apparent that metal mining could be made less hazardous by similar safety rules; but, even now, in most States, the metal-mining regulations are much less stringent than those pertaining to coal mining.

The advent of workmen's compensation laws gave the needed impetus to employers in all forms of industry to investigate the causes of accidents and to take means to prevent them. The National Safety Council has become the largest and most efficient agency for this important work in the industrial field generally. In mining, the work has been aided efficiently by the U. S. Bureau of Mines and the mine inspection departments of the various States. Safety engineers and safety committees are becoming more and more common in the metal mines of the country.

That safety and efficiency go hand in hand—that they are, in fact, one and the same thing—has become an indisputable fact. Although an inefficient machine or faulty practice may be safe, an unsafe piece of machinery or an unsafe practice is never efficient in the long run. There is nothing more inefficient than an accident. "Practically every accident that happens in the mine, from a bruised finger to a fatality, costs something in loss of time and demoralization of work. In some parts of the United States, the men all walk out of the mine in case of a fatal accident and do not return until the dead man is buried. When a man is seriously injured he requires the aid of others. His work stops, and the work of those coming to his assistance stops. There is a further loss from the curiosity-mongers, who want to know what is going on, and also from those required to carry the injured man from the mine to the first-aid room."* Aside from the paramount humanitarian considerations, it pays to do all that can possibly be done to prevent injury to workmen—to make every effort to conserve human life and usefulness.

Recently the idea has been advanced that accidents are symptoms of inefficiency. This is undoubtedly true in many cases. For instance, a trammer has a rib fractured when a derailed car, which he is trying to return to the track, tips over and crushes him against the side of the drift. It is not unlikely that investigation will show that where this occurred there was a bad piece of track—that cars had been derailed there before. Because no one had happened to get hurt, this bad place had been overlooked; but considerable loss of time had resulted by derailment of cars or the necessity to slow down to prevent derailment. As another example, a miner is overcome, perhaps with fatal result, by powder-smoke in some particular working. It is more than possible that the air is frequently bad there, and that the men suffer with 'powder headaches'; they are in the habit of going several times a day to some other part of the mine where the air is fresh; and, in general, are not able to work so efficiently as they could in an adequately ventilated working-place. As a third example: the clothing of a man oiling a piece of machinery is caught in a gear and he loses a finger, or perhaps an arm. If the oil- and grease-cups were piped out beyond the danger-point they would be handier to reach and could be filled in much less time than when placed in dangerous and consequently inconvenient places. There is no limit to the number of similar examples that might be cited, indicating clearly that a large percentage of accidents can be prevented by exercising a reasonable amount of foresight. The idea that every accident is an 'act of God' is out of date; nearly all accidents are direct results of carelessness or ignorance, or both. Of course it is not possible to prevent all accidents; but by education, by using every possible safeguard, and by example, those in authority can reduce the number of accidents to a minimum far below the present average.

The principal causes of severe and fatal accidents in mines are falls of ground and falls of persons down shafts, raises, or winzes. The methods of obviating these have been discussed often, and should be well enough understood to make it unnecessary to do more than mention them. Eternal vigilance in seeing that backs are picked down, or adequately supported, before working under them, and that all openings are guarded properly are the only means of preventing such accidents. There are, however, a good many other hazards, not so generally recognized, that give rise to recurring accidents which, although not usually severe, might be prevented easily.

Accidents due to explosives are not frequent and those that occur are nearly always the result of gross carelessness. The manufacturers have given such wide publicity to the precautions necessary to the safe storage and use of dynamite and other explosives that there is no excuse for a mine operator who does not know how to handle them properly and safely. One point that does not seem to be emphasized strongly enough in the powder companies' pamphlets is that magazines should be lighted from the outside. Electric-light wires inside a magazine have caused serious explosions, and must always be regarded as dangerous. If it is impossible to light a magazine adequately from without, flash-lights or battery-lanterns can be used.

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*'The Human Element in Mine Operation', by Edwin Higgins, 'M. & S. P.', Mar. 6, 1920.

The use of calcium carbide has introduced hazards that are not always understood fully. Carbide should be regarded as an explosive and treated as such. It should never be stored with dynamite or other explosives. Carbide drums are frequently kept underground, particularly in small mines, or in those where a number of different lessees are working. Every once in a while, when a miner goes to one of these drums to fill his lamp, there is an explosion, and he is more or less severely burned. Such accidents could be prevented by keeping the large carbide containers on the surface and by taking the carbide underground in small quantities only. The large drums may be kept safely underground if there is a dry electrically lighted chamber available and if open lights are kept away from them. There is usually enough moisture in the mine atmosphere to cause a slight decomposition of the carbide, with the consequent formation of acetylene. Generally the gas is not mixed with the air in the proper proportion to form an explosive mixture; or, if such a mixture is formed, it has a chance to diffuse itself before the miner's light gets close enough to ignite it. Calcium phosphide may be present in the calcium carbide. This, with water, will form hydrogen phosphide, which ignites spontaneously on coming in contact with air.† This is one of the reasons why carbide should not be stored with other explosives.

The emptied carbide drums are frequently used for a variety of purposes around the mine; sometimes failure to wash them thoroughly results in explosions in which someone is burned. For instance, some years ago it was the practice in a certain mine to use them for latrines, and one exploded while being so used. To avoid such accidents the cans should be filled completely with water as soon as the carbide is removed.

Arcs formed while operating unprotected switches frequently cause severe burns. This is perhaps the commonest form of electrical accident around mines and mills. There are a number of closed switches now on the market that cannot be operated except when the blades are protected. Their use precludes this kind of accident.

Trammers often have their hands or fingers mashed while pushing the ordinary hand-operated mine-car, sometimes because they place their fingers inside the top of the car, where part of the load can crush them; sometimes they are caught between the car and a timber or projecting point of rock on the side of the drift. A well-designed handle would prevent such accidents and would make the car easier to handle. A car with such a handle is illustrated in the National Safety Council's pamphlet, 'Underground Mine Cars and Haulage'.

Minor eye accidents are too frequent in metal mines. They occur chiefly while starting holes with machine-drills, while cutting hitches with moils, and while breaking up large pieces of rock with hammers. The remedy is to wear goggles. However, there is considerable difference of opinion as to the advisability of wearing goggles underground. Many competent persons, probably the majority of mine superintendents, believe that the goggles would, by partly cutting off full vision, cause other and more serious accidents. This is doubtful. Probably the real difficulty is that of persuading the men to wear them. The use of goggles to prevent eye injuries in manufacturing plants is rapidly becoming universal, and it is to be hoped that before long the same will be true of metal mines.

Unguarded gears, belts, and other moving parts of machinery are responsible for most of the accidents in surface plants and mills. All well-designed modern machines have the gears and other moving parts adequately guarded by the manufacturers. Belts, pulleys, and shafting, as a rule, must be guarded by screens or railings after they are installed. Practically all moving machinery that is not guarded from accidental contact offers a possible and often an extremely dangerous hazard. Loose clothing or waste that projects from a pocket is apt to catch and pull the wearer around a smooth shaft, often with fatal results. Projecting set-screws are especially dangerous, and should never be tolerated. Throwing belts on and off their pulleys by hand without shutting down causes many accidents. Not infrequently a man applying belt-dressing gets an arm crushed or broken when it is caught and carried around the pulley. If care were taken to always apply the dressing on the side of the belt running *away from* the pulley, or far enough from the pulley to make it impossible to get caught, such accidents would not occur.

It seems almost childish to say that crusher- and roll-men ought to keep their hands away from the crushing faces of these machines. Yet, in spite of the fact that bars and tongs are almost universally provided for the purpose, men will not infrequently try to dislodge an obstinate piece of rock with their hands. If they are lucky they may only lose a finger or two, or perhaps an arm; occasionally the results are fatal.

Such accidents, when every safeguard is provided, may tend to discourage the management in its efforts toward safety, but they should not be allowed to do so; rather they should be used to point a moral and to discourage the spirit of taking chances such as are pictured in Berton Braley's 'Gamblers':

"We'll take a chance—we're not afraid of dangers,
There's nothing killed us yet, so we're all right.
To every sort of worry we are strangers,
And so you see us, always gay and bright;
Maybe some day the roof will fall and get us,
The dynamite may go off in advance,
The gas explode, but we won't let it fret us,
We'll take a chance."

A DEPOSIT of descloizite has been discovered near Messina, in the Transvaal. Descloizite is a vanadate of lead and zinc, and in this particular case contains over 22% of vanadium pentoxide.

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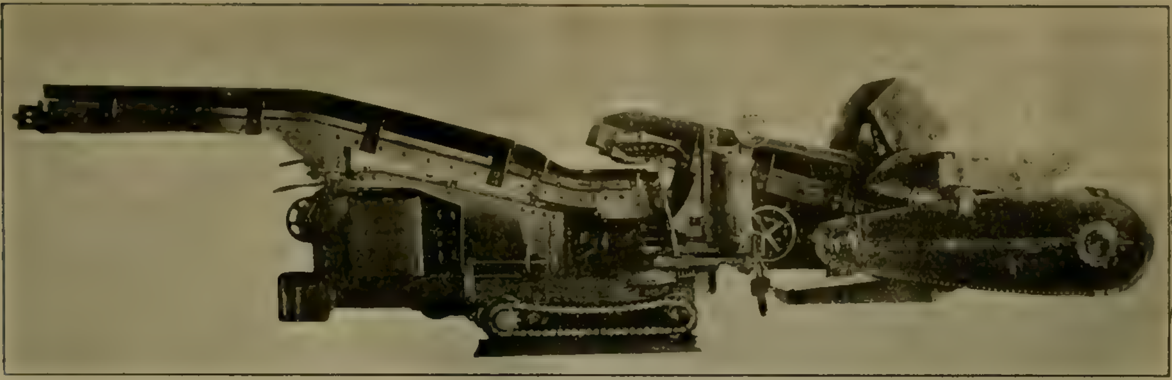
†'Danger of Storing Carbide With Explosives', by Charles E. Munroe, Reports of Investigations, U. S. Bureau of Mines, 'M. & S. P.', Vol. 123, p. 899, Dec. 24, 1921.



MYERS-WHALEY SHOVELING MACHINE

Underground Loading Devices in Metal Mines

By C. Lorimer Colburn

*The diverting of men from industry to war focused the attention of operators in this country upon mechanical means of doing things. The demand for man-power was so insistent that every available agency for multiplying it had to be employed. It was during the war period and immediately thereafter that development of the use of underground loading devices made rapid progress. In all parts of the United States, mining engineers and mine managers were diligent in their efforts to develop mechanical loaders. The mining engineers of the U. S. Bureau of Mines have secured, with the co-operation of the operators, data on the actual performance of the mechanical shovels in their districts, and have made them available to me.

No effort has been made to discuss exhaustively the subject of underground loading devices. It has been the object to collect, in one paper, records of the performance of all machines now in actual use. Improvements in the design of machines are constantly being made; the performance-records given in this paper relate to operation prior to March 1, 1921. The records prior to 1920 may not fully represent the work that could be accomplished with the present models of the same machine.

The data secured are given exactly as reported by the mine-operators. Since these data were collected, two underground loaders, of a different design, have been put into operation in the iron mines of the Lake Superior district. One is the John Mayne sub-level loader, being tried by the Cleveland-Cliffs Iron Co., at Ishpeming, Michigan, and the other is the Cole-Goudie shovel, being tried by the Oliver Mining Co., at Ironwood, Michigan. No information has been secured regarding the performance of either of these machines.

The adaptability of a machine to particular work depends not only upon its construction but also upon the ability of the operator to make the machine perform. Part of the data herein given may appear to reflect upon the loading device in question, whereas the failure may be chargeable to lack of skill on the part of the operator. Likewise, the costs given do not represent a comparison of the machines, because no two mines are alike, and shoveling costs are extremely variable. Thus, the hand-loading costs in Mine A may be 45 cents per ton, and a mechanical shovel may handle the same material for 40 cents per ton. The conditions in Mine B may be such that hand-shoveling can be accomplished for 25 cents per ton, and mechanical-shoveling for 24 cents. It would be unfair to state that the loader in Mine B is better than the one in Mine A because its operating cost is less.

Hunt Rotary Shovel

The Hunt rotary shovel is cylindrical, and carries four digging-buckets, and a belt-conveyor to take the material from the buckets to a car. The entire machine, with the necessary power plant and transmission parts, is housed in a steel case; none of the working parts is, therefore, exposed to the dirt and moisture of the mine. It is mounted on a truck and will run on the ordinary mine-track. The power is furnished by a 15-hp. motor placed immediately below the belt-conveyor. The buckets are arranged so they can swing back inside the cylinder. The motion to the buckets is imparted by two cams, which force the buckets out of the cylinder at the proper time and pull them inside the cylinder again after the material has been discharged. The revolving cylinder with the digging-buckets can be moved to the right or to the left by a rack-and-pinion arrangement on the truck. The machine is so pivoted at the rear end of the conveyor-belt that it is possible to deliver the material to the car irrespective of the position of the revolving cylinder. The Hunt rotary shovel is a low, compact, and powerful machine.

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*Abstracted from Reports of Investigations, U. S. Bureau of Mines.

Operation. The shovel is controlled by an operator who stands to the right of the machine near the front, where he can see the digging operations. In order to shovel from a pile of broken material, the revolving cylinder is pushed into the pile, the bottom of the cylinder almost resting on the floor. As the cylinder revolves, each bucket in its turn takes a load of material and later drops it upon the belt-conveyor. Immediately after dumping this load, the bucket swings back into the cylinder. As soon as it has passed the lowest position of the cylinder, the revolving motion imparted to the bucket by the cylinder, together with the protruding motion given to it by the cams, pushes the bucket into the pile with a motion somewhat like that of an ordinary shovel.

As soon as the material is dumped upon the belt-conveyor, it is carried up an incline and discharged into the car at the rear. The edges of the belt-conveyor are concealed by a guard-strip, which troughs the conveyor and prevents any of the material from falling off. By the rack-and-pinion arrangement described above, the revolving cylinder can be swung to the right or to the left; this enables the machine to dig within 10 ft. to either side of the centre of the track.

Record of Performance. The Hunt rotary shovel has been in operation at the Mayville iron mines operated by the Steel & Tube Co. of America. The management states that the machine has loaded as many as 116 three-ton cars in 8 hours. No records of the performance of this machine over a long period of time are available.

Myers-Whaley Shoveling Machine

The Myers-Whaley shoveling machine is composed of three principal parts: the main frame, the swinging jib, and the rear conveyor. The main frame is mounted on wheels running on the ordinary mine track. The machine is self-propelling and can be moved forward or backward at the will of the operator. It is driven by a 20-hp. motor, which is mounted on the main frame. The jib section and the rear conveyor are attached to the main frame near the centre of the machine by a king-pin, and both can be swung to the right or left. The jib section carries an automatic shovel mounted on its forward end. Behind the shovel is an armored belt, which receives the material from the shovel and delivers it to a second armored belt mounted upon the rear-conveyor section. The jib is pivoted on the king-pin, and can be swung 45° to either side. The rear-conveyor section consists of an armored belt mounted on a frame that is pivoted on the king-pin, allowing the rear conveyor to be swung 20° to either side.

The Myers-Whaley machine is manufactured in two sizes—No. 3 and No. 4. No. 4 is the standard-size machine and weighs 18,500 lb. The machine can be arranged for any track gauge. It can be transported on a track as narrow as 18 in.; but while operating it is necessary to have it supported on at least a 42-in. gauge track. With narrower gauges than 42 in. it is necessary to lay extra rails at the place where the machine operates, for unless this extra support is provided, the machine may tilt sufficiently to cause derailment when digging at extreme distances from the centre of the track. The overall length of the machine is 22 to 26 ft., depending upon the length of the rear conveyor, which of course is controlled by the length of the mine car. The width is 5 ft. 4½ in., and the height, 4 ft. 9 in. In some places the height of the mine-car makes it necessary to raise the rear conveyor, which of course raises the height of the machine. The wheel base is 42 in., the width of shovel 34 in., and the size of motor 20 hp. The shovel on the jib has a reach of 10 ft. to either side of the centre of the track.

The No. 3 machine weighs 13,000 lb., and the track gauge is adaptable just as for the No. 4 machine. The length of machine is 23 ft., the width 4 ft. 8 in., and height 4 ft. 3 in. The shovel on the jib has a reach of 8 ft., to either side of the centre of the track. The shovel is 33 in. wide. The power is obtained from a 15-hp. motor. All the parts of the Myers-Whaley shoveler have been standardized. The machine has been designed for strength; the various parts are well protected, and are able to withstand heavy knocks.

Operation. The operator is seated on a platform at the right of the jib section, well above the work and where he can observe the action of the shovel and the belt-conveyor on the jib section. The shovel is automatic, the front part having an orbital movement, down, forward, upward, and back, which clears the material away for the next stroke. In lumpy material, this action of the shovel is augmented by moving the machine bodily forward as the shovel comes down and forward, then moving the machine partly backward in preparation for the next stroke. This bodily reciprocation of the machine is at the will of the operator. The shovel discharges its load upon the front conveyor-belt, on the jib, from which it is discharged to the rear conveyor-belt, which in turn carries the load backward and delivers it to the mine-car.

Record of Performance. The Myers-Whaley shoveling machine was one of the first to be placed on the market. It has, perhaps, been in general use and has been tried in a greater number of mines than any other machine. It was, to a certain extent, the pioneer, and so has borne the brunt of the criticism that is usual when new methods are suggested for doing things. The experience with it has been varied. In one mine, the Myers-Whaley shoveler has been in use for three years. The manager gives the following results: During 1918, more than 30,000 tons of material was shoveled at a cost of 20.07 cents per ton. This cost was divided between repairs, 9 cents per ton, and operating labor and supplies, 11.07 cents. During 1919, nearly 39,000 tons was shoveled at a cost of 19.15 cents per ton, and during 1920, nearly 40,000 tons was shoveled at a cost of 20.69 cents per ton. The tonnage on individual machines varied according to height of ground, amount of ore available, and the time required for switching cars. The average was about 100 tons per 8-hr. shift; but when it was possible to work 5 or 6 hours in one or two headings, 130 to 150 tons was loaded. The crew consisted of one operator and one mule-driver. The operator would break up boulders while the driver was switching cars.

In another mine a test was observed by a Bureau of Mines engineer. The machine had one runner, two helpers, and a shoveler in attendance. A locomotive was kept constantly at hand for switching purposes. The machine readily shoveled the 4½ tons necessary to fill the car in three minutes, after which 10 minutes was taken to switch the loaded car about 500 ft. and to replace it with an empty one. Over a period of two hours this machine handled cars at the rate of one car for every 15 minutes, or 18 tons per hour. A shift's work was about 125 tons.

In another mine, the Myers-Whaley machine was used to handle material in a stope. The machine in this mine was compelled to work on a grade of from 5 to 10%. It worked well on a 5% grade and with difficulty on a 10% one. The face was 10 ft. high. During the period that observation was made, the machine shoveled 2653 tons, which was at the rate of 12 tons per hour. The costs were as follows: shoveling 20.80c., drilling 8.71c., blasting 15.39c., total 44.9c. per ton. The cost of doing the same work by hand was 58.5c. per ton.

In July 1918, Witherbee, Sherman & Co. purchased for its Harmony mine, one No. 4 Type Myers-Whaley shoveling machine. In June 1920 three additional machines were purchased. The material handled was magnetic iron ore. Wages paid the shovel-runner were 57½c. per hour; to the helpers, 47½c. per hour. Five men ran the machine and handled the cars. The average distance of tram was 250 feet.

HUNT ROTARY SHOVEL

Operating Costs of Myers-Whaley Shoveler for 1920

	During 7 months			During 12 months
Tonnage	12,459	10,365	9,996	12,387
	Cents	Cents	Cents	Cents
Operating labor cost	12.7	14.8	14.8	19.1
Repairs, labor cost	3.1	5.4	3.0	15.0
Repairs, supply cost	8.7	10.0	9.6	28 0
Shops and miscellaneous	0.4	0.1	0.1	3.8
Power	0.4	0.4	0.4	0.4
	52.2	30.8	27.9	66.3

Machine No. 4 was the one purchased in 1918. During the year it was almost re-built except for motor and frame.

In October 1918, a Myers-Whaley machine was put in operation at the Priest Portal of the Hetch-Hetchy aqueduct, in Tuolumne county, California. On January 1, 1920, three machines were being used on this property, and on January 1, 1921, thirteen machines were employed. Eight of the thirteen were kept busy in the headings and five were maintained in reserve.

The following table gives the cost for operating the first Myers-Whaley machine, from October 1, 1918, to October 1, 1919. Although these costs are much in excess of the cost today, they give a fair comparison of what can be expected. The machine did not work continuously; while it was stopped for repairs the material was loaded by hand. These figures include pushing the cars by hand from the heading to the switch, varying from 50 to 200 ft. in distance; the progress made during the year was 2357 feet:

Labor cost:	Total	Per ft.
Operation	$2,824	$1.20
Repairs	1,037	0.44
Shoveling	7,220	3.063
Electrician	1,305	0 553
Total labor	$12,386	$5.256
Replacement machine parts (f.o.b. Priest)	3,624	1.537
Electrical plant and material depreciation, 38%	867	0.368
Depreciation on Myers-Whaley machine, 20%	1,944	0 824
Power, 120 kw-h., at 0.005c.	216	0.09
	$19,037	$8.076

The outside section of tunnel was broken 11 ft. 3 in. by 11 ft. 3 in., making 126.56 cu. ft., or 10¼ tons of material for every lineal foot of tunnel. The cost of shoveling 10¼ tons was $8.08, or 79c. per ton. The cost of handling similar material in the South Fork heading, where the entire work was done by hand, was $1278 for labor. The distance was 201 ft. The size of the tunnel was the same as that of the Priest Portal. The cost was, therefore, $6.35 per lineal foot, or 60c. per ton. It will be noted that the cost per foot of loading the broken rock was $1.90 greater in the Priest Portal tunnel, where a mechanical loader was used, than in the South Fork, where hand labor was used exclusively; but with the loader a greater speed was obtained. It took the machine four hours to load the broken rock from each round in the Priest Portal heading, against eight hours to do the work by hand. When the loader was working the material could be cleaned out of the tunnel by the time the upper holes were drilled, and the drillers did not have to wait for the face to be cleaned up as in the case of hand shoveling. With greater speed the overhead expenses are less.

A new Myers-Whaley machine was installed in the Early intake in January 1920, and the cost of driving this tunnel was reduced from $28 to $22.18 per foot. When the loader was used, the round was drilled and blasted in a shift and a half instead of in two shifts. Two loaders were placed at the Priest Portal, so when one broke down the other could be taken in to load out the round. One of the main considerations in the successful use of this machine is a competent runner and mechanic who understands how to keep it in good condition and make the necessary repairs. This was brought out forcibly in connection with this project. In July 1920 there was a strike. Previous to this, several of the machines were kept in the heading for several months without being taken out for repairs. In November 1920, after starting up with a new set of men, very often both the machines assigned to a heading were in the shop at the some time. At the South Fork heading 40 holes were drilled in 14 hours, and 13 lineal feet of tunnel was broken in a round. The Myers-Whaley machine ordinarily loaded the broken rock in 5½ hours. This was at the rate of 9.1 cu. yd. per hour.

Conweigh Digger Belt-Loader

The Conweigh digger belt-loader (see page 129) consists of a dipper mounted on the forward end of a dipper-arm, a belt-conveyor, an electric motor, and accessory parts. All these are mounted on a truck, which runs on the regular mine-track, and are so arranged that the dipper, after digging into a pile of loose material and receiving a load, slides it upon the belt-conveyor, which discharges into a car in the rear.

The dipper is hinged to the dipper-arm, and can be swung 90° in a vertical plane. Both the front and top of the dipper are open. The dipper-arm is so constructed that it forms a trough, through which the material slides from the dipper to the belt-conveyor. The movement of the dipper on its hinge and the vertical motion of the dipper-arm are controlled by a chain, which is attached to the dipper. The discharge of the dipper is accomplished by swinging it up and back, so that it discharges through its top, instead of swinging it horizontally and discharging through the bottom as is usual. The edges of the belt-conveyor are protected by a guard-strip, and the sides of the conveyor-section are built up with wing-boards. The power for the entire machine is furnished by a 15-hp. motor.

Operation. The machine is controlled by an operator who stands on a small platform on the right of the machine, near the front, where the digging operations can be observed. The mine-car is coupled to the machine in the rear. The dipper-arm is lowered so that the bottom of the dipper scrapes along the floor. The machine is then moved forward, which crowds the dipper into the pile. As soon as the dipper is full it is raised 90° on its hinge, so that the open front is not at the top. The dipper-arm is then raised, which allows the material to slide out of the dipper down the trough-shaped dipper-arm into the pocket, which feeds the belt-conveyor by which it is carried to the car in the rear.

Record of Performance. The machine has been in operation for some time in the mines of the National Lead Co., at St. Francois, Missouri. The record for the month of February 1921 was an average of 96 tons of ore loaded in an eight-hour shift with one operator and one helper; 3360 tons was loaded during the month. These two men not only load the cars but push the empty one-ton cars to the machine and deliver the loaded cars to the motor-haulage loop. A labor cost of 9½c. per ton was reported for operations during February. To this should be added the cost of power and repairs. The management expects to reduce the present loading costs of 16.64c. per ton by using this machine.

Conweigh Shovel-Loader

The Conweigh shovel-loader (see page 129) consists of a boom on the end of a steel frame. An electric motor and the necessary mechanical parts are also mounted on the steel frame, which is on a truck, and can travel anywhere on the regular mine-track. A dipper slides back and forth on the boom. The boom can be swung to either side or up and down.

Operation. The loader is controlled by an operator who stands to the right of the machine. The movement of the dipper and boom is controlled by two levers. The dipper is pulled into the pile of material; and, after filling itself, is raised over the car. As soon as the dipper is over the car, the door in the bottom is tripped by the operator, who pulls a rope.

Record of Performance. During 1920, at the St. Louis Smelting & Refining Works of the National Lead Co., of St. Francois, Missouri, 169,351 tons of ore was loaded by seven of these machine, which made an average of 62.4 tons loaded per shift, at a cost of 16.64c. per ton. The costs were distributed as follows: operating labor, 14.9c.; repair labor, 0.3c.; supplies, 0.99c.; power, 044c.; total, 16.64c. per ton.

'Shuveloder'

The 'Shuveloder' (see page 130) is operated by compressed air, which drives the dipper into a pile of loose material, lifts the loaded dipper, and empties it into the car that is brought up immediately behind the machine. The dipper, together with the four air-cylinders that operate it and the mechanical parts that impart motion to the dipper, make up what is known as the main body of the machine. All these are mounted on a truck, which can be moved on the ordinary mine-track. The machine is hand-propelled. Immediately above the truck and beneath the main body is a turntable, which provides lateral movement. The 'Shuveloder' is the latest model of what was formerly known as the Armstrong loader. Its overall length is 6 ft.; overall width, 4 ft.; overall height, 4 ft. The weight is approximately 4300 lb. The dipper is 30 in. wide, and the head-room required for operation is 6 ft. 10 in. The manufacturers state that it takes from 150 to 175 cu. ft. of free air per minute at 80 lb. pressure to operate the machine. It will load material in any car of a height 50 in. or less above the top of the rail.

OPERATION. The shoveler is controlled by three levers on the right-hand side of the machine. The operator stands on the ground. The 'Shuveloder' is not designed for continuous operation, but each motion has a separate control, which is reversible. The mechanism is driven by three series of cylinders. The air is admitted successively into the bottom cylinder, into two centre cylinders, and then into the top cylinder. The bottom cylinder gives motion to the body, pushing it forward and crowding the dipper into the pile of loose rock. The two centre cylinders turn the two rope-sheaves, which raise the dipper up through the pile. The top cylinder then pulls the cross-head back, causing the dipper to swing over the top of the machine and to discharge the material into the car in the rear. Simultaneously with the operation of the upper cylinder, the bottom cylinder receives air, which causes it to pull the body-piece back to the starting position. The air is admitted to the rear end of the other cylinders in their turn, which brings them all back to the starting position. There is no movement to the truck, which is clamped to the track. The lateral movement to the machine, which is provided on the turntable, is obtained by a ratchet that is worked by hand. The machine has a reach of 5½ ft. to either side of the centre of the track, and always discharges into the centre of the car behind, from any lateral position of the body-piece.

One man is required to operate the machine and one to switch the cars. In some places where digging is difficult a third man is used as a helper. At one mine the loader was used intermittently. Working on rock it shoveled 72½ cars of 2⅘ tons capacity in 35½ hours, at a cost of 25.09c. per ton. This included tramming the cars 370 ft. The actual time of loading was 16¼ hours. The delays were due to tramming, switching, loader off track, and repairs. In another test, working on soft iron ore, 208 cars were loaded in 139¼ hours at a loading cost of 12.97c. per ton. The actual loading time was 24½ hours.

COLBY MINE. An Armstrong No. 11 shovel was in use at the Colby mine of the McKinney Steel Co., of Bessemer, Michigan, to load broken rock in driving drifts. The drifts are 7 ft. high by 8 ft. wide, and the pile of rock is about 19 ft. long and about 4 ft. high at its deepest place. There were about 14 carloads (each of 32 cu. ft.) to the pile. Two men were used in loading: one operator, and one attendant who switched the cars. The machine was observed during the shoveling of one of these piles of material with the following results:

Total time of setting up machine, 10 min.; time of loading 14 cars, 58 min.; 12 move-ups of loader, 30 min.; switching 12 cars, 92 min.; total, 190 min. Total number of cars loaded, 14; total cubic feet, 448; total number of move-ups, 12; total number loader-dippers, 222; average number of loader-dippers to car, 16; average number of loader passes per minute, 4; average time for loading cars, including move-ups, 6 min.; average time for loading one ton of rock, including move-ups, 2.4 min.; total time required for setting up the Armstrong shovel, loading and tramming of the rock, broken from an average break of a round of holes, took 1 hour and 45 minutes.

THEW UNDERGROUND MINING MACHINE

The Thew Automatic Shovel Co., of Lorain, Ohio, has designed an underground mining shovel upon the same general lines as the contractor's electric shovel manufactured by the same company. It consists of a dipper, boom, operating mechanism, and truck. The dipper is constructed of the same material as used in the regular Thew electric shovel. Its capacity is about ⅝ cu. yd. The boom is rigid, being built up of steel so as to require minimum head-room. The operating mechanism consists of a 20-hp. motor, the necessary gear, and other mechanical parts. The operating mechanism is mounted on a platform. Below the platform is a turntable, which revolves the entire shovel through a full circle of 360°. The machine is carried on the truck, which is on a caterpillar tractor; it is self-propelling.

OPERATION. The operator has a seat on the platform that supports the operating mechanism. From here he can observe the action of the dipper and also keep watch over the performance of the operating mechanism. The motions of the shovel are controlled by levers. The dipper is forced into the pile of material by a movement imparted to the dipper-arm and by the pulling of the dipper-chains. When the dipper is full, the dipper-chains are tightened, so as to pull the dipper into a vertical position. The shovel is then swung on its turntable until the dipper is over the car. The bottom of the dipper is then tripped, allowing the material to drop into the car. The Vinegar Hill Zinc Co., at Platteville, Wisconsin, has operated Thew electric shovels in its mines in the Oklahoma-Kansas-Missouri district and in the Wisconsin-Illinois district.

OKLAHOMA-KANSAS-MISSOURI DISTRICT. At the Barr mine, in Kansas, near Picher, Oklahoma, the orebody is mined in stopes from 20 to 45 ft. high by the mining method common to the district, excepting that 1½-ton cars instead of ½-ton cars are used, and accordingly the shaft is equipped with cages. A Type No. 0 Thew shovel was installed in April 1919. This is of a standard type, revolving in the full circle, is self-propelled, and is mounted on a 4-wheeled truck. It was found to be more flexible than other loaders then being tried in the district, because the full-circle swing allows ore to be loaded at any point—

front, back, or to either side—within the radius of the boom. Three dipper loads fill one 1½-ton car. Over a period of 20 weeks the average loading per eight-hour shift was 160 tons at about one-half the cost of hand shoveling.

Wisconsin-Illinois District. At the Meloy mine, at New Diggings, Wisconsin, two Type No. 0 Thew shovels have been installed. The shovels, like that at the Barr mine, are electrically driven, self-propelled, and mounted on wheels. The head-room required is a minimum of 16 ft., and the operating width required is at least 20 ft. The stopes are 50 ft. high by 25 ft. wide, providing ample working space and sufficient broken ore to ensure the shovel being kept in continuous operation. Dippers of ⅝ and ¾ cu. yd. are used. The machines weigh about 15 tons, but can be dismantled readily so as to lower the parts through a 6 by 6-ft. shaft compartment.

A crew consists of one operator, who should be a careful and experienced man; one helper, unskilled; and one mule-driver and mule, handling 1½-ton cars. Such a crew, under suitable conditions, should easily load 175 to 230 tons per 9-hour shift.

Following is the operating record for the period from November 24, 1917, to August 16, 1919, for one of the shovels at the Meloy mine:

Total shoveled, tons		27,177
Total shifts worked		211
Average working time per shift, hours		3.85
Average tons shoveled per hour		33.4
Average tons shoveled per shift		129.3
Cost per ton:	Cents	
Labor	11.06	
Power	0.70	
Repairs	1.09	
Total, cents		12.85

The cost of hand-shoveling during the same period was 23c. per ton, approximately. In both instances, the tramming to the main haulage loop is included in the cost of working the Thew shovel.

A two-months operating record for two shovels at the same mine during January and February 1921 is as follows:

	Shovel No. 1	Shovel No. 2
Tons shoveled	10,987	5,917
Shifts worked	80	42
Hours per shift	7	7
Labor cost per ton, cents	11.7	11.3
Power cost per ton, cents	1.3	1.3
Repair cost per ton, cents	0.7	0.7
Total cost per ton, cents	13.7	13.4

The cost of hand shoveling during the same period was approximately 16c. per ton. In all cases the cost of tramming 200 ft. to the shaft was included in the labor cost in connection with the operation of the Thew shovels.

Record of Performance, Harmony Mine. Five Thew shovels were purchased by Witherbee, Sherman & Co.; the first in September 1917, two in 1918, and two in April 1919. Three of these shovels were put in operation at the Harmony mine. Below is given the record of the three shovels for 1920:

	Thew No. 1	Thew No. 2	Thew No. 3
Tonnage	23,398	26,134	27,720
Distance trammed	158	210	395
	Cents per ton		
Operating labor cost	16.2	14.9	16.0
Moving labor cost	1.2	0.3	0.7
Repairs, labor cost	6.0	2.1	2.6
Repairs, supply cost	10.0	5.2	7.0
Shops and miscellaneous	4.1	1.6	1.9
Power	0.4	0.4	0.4
Total cost	38.5	24.5	28.6

The No. 1 shovel is the oldest, and the repair cost in operating it was the highest. After the first two years the repair bills increased rapidly. This would naturally be expected in the case of a machine that receives rough usage underground. The ore was hauled away from the shovel in 54-cu. ft. gable-bottom cars. The Thew shovel in No. 2 stope worked against a 40-ft. face. The vein at this point was 60 ft. wide. Tracks were laid on either side of the shovel. The car on one track was loaded, then the car on the other track was loaded while the first car was being trammed to the shaft and emptied. It took four minutes to dump the car and return it to the shovel. The shovel had difficulty in picking up large lumps and scraping the bedrock.

Mascot Mine. The Thew shovel is in operation in one of the large stopes in the Mascot mine of the American Zinc Co., at Mascot, Tennessee. Zinc ore is mined in the form of sphalerite occurring in limestone. The mine has an open stope about 200 ft. high. The ore is loaded into steel cars, each with a capacity of about two tons, and hauled by mules to a side-track, from which the cars are taken to the shaft bottom by electric storage-battery locomotives. The stopes are large, so that there is plenty of room for the machine to operate. The Thew was put in operation in August 1920, and in the succeeding three months handled 6335 tons of ore at a cost of 17.55c. per ton.

The Chateaugay Ore & Iron Co., Lyon Mountain, New York. In 1918 this company secured a Thew shovel for use in its No. 4 mine. Records of performance, cost, and up-keep were not kept. Another shovel of the same make was procured for the No. 5 mine, but was used very little and was later transferred (March 1919) to the No. 1 mine. Labor costs for the Thew shovel in No. 1 mine are for one operator, $5.25; one operator's helper, $4; three trammers at $4 each, $12; total, $21.25; 200 tons of ore was handled per shift, making a cost for labor of 10.62c. per ton. This shovel worked in a large stope 40 ft. wide and 45 ft. high. Cars are pulled in, and are drawn out by mule. A switch was arranged 100 ft. from the shovel, and the cars pushed up to the shovel by hand for this distance. Side-dump cars of 40 cu. ft. capacity are used; they hold 2¼ tons. Much time was lost in switching cars.

At the No. 4 mine a Thew shovel was also in operation. This shovel handles 300 tons per day, at a cost for labor of 6c. per ton. A tail-rope is used for switching cars. Two tracks lead to the shovel, so that one car is being loaded while another car is being pushed in. The shovel operated almost continuouusly. The full haul for cars is 600 ft. Alternating current, 220 volts, was used. Power costs about 2½c. per kilowatt-hour. It is estimated that the power cost was about $1 per day per shovel. The shovel was often out of commission on account of repairs. The most serious trouble experienced was the breaking of an I-beam on the No. 1 shovel. The rawhide pinions wear rapidly, the average life being about three weeks. It is estimated by this company that the cost to handle ore by hand was 35c. per ton in the No. 1 mine, and 44c. per ton in the No. 4 mine. Cost for repair (labor and supplies) was about 5 or 6c. per ton.

St. Joseph Mines. The St. Joseph Lead Co., of Bonne Terre, Missouri, has six Thew shovels in operation in its mines. The stopes are large, giving ample room for operation. All these machines were put in operation in 1920. The record of their performance is as follows: Thew No. 1 loaded 8713 tons at a cost of 14.98c. per ton; No. 2 loaded 26,970 tons at 18½c; No. 3 loaded 12,194 tons at 18.8c.; No. 4 loaded 20,917 tons at 16.65c.; No. 5 loaded 4969 tons at 29.34c.; and No. 6 loaded 4881 tons at 28,13c. per ton.

The higher costs for shovels No. 5 and 6 are due to their being used in mines where conditions are less favorable for their operation, the stopes being smaller, and operations being frequently interrupted. The average for all six shovels is as follows: 78,644 tons loaded at a cost of 19.96c. per ton. These costs are distributed as follows: operating labor, 11.025c.; repair labor, 4.115c.; material, 2.895c.; power, 0.933c. per ton.

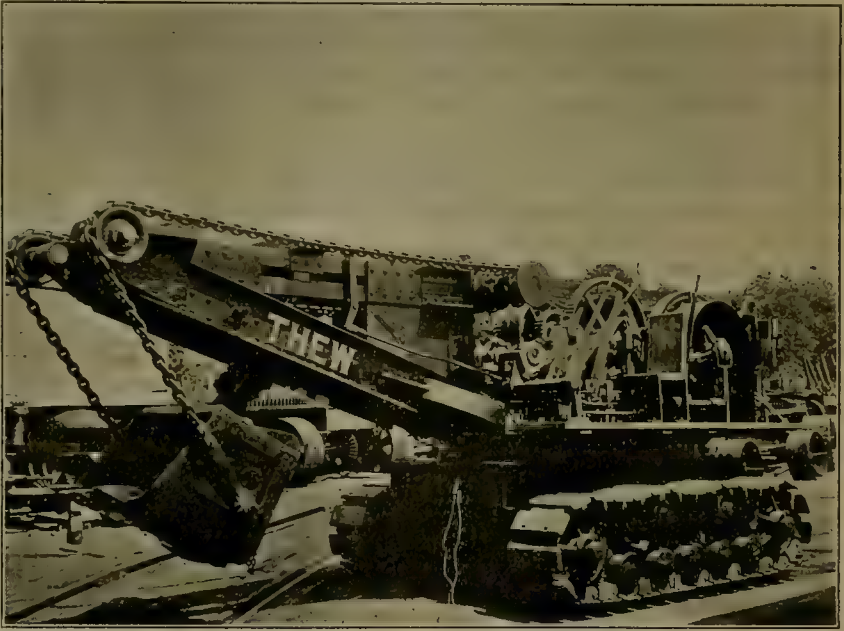
Marion Shovel

Although the Marion shovel is not manufactured primarily for underground use, the smaller-sized machine has been purchased and put in operation underground by several mining companies.

Construction. The Marion shovel consists of a dipper, boom, and operating mechanism, the latter being mounted on a platform. An electric motor furnishes the necessary power. The machine is controlled by a set of levers convenient to the operator, who sits on the platform, where he can observe the movements of the dipper and the working of the machine. The dipper is crowded into the pile of material by a movement given to the dipper-arm and the dipper-chains. When it is filled, it is raised and swung until brought over the car. The bottom of the dipper is then tripped, dropping the material into the car.

Record of Performance. The Marion shovel was placed in operation in August 1920 in the mines of the American Zinc Co., at Mascot, Tennessee. Records of performance for three months are as follows: total number of tons handled, 8997; cost 19.7c. per ton. The distribution of costs is as follows: operation is 17.60c.; repairs, 2.11c. On account of this being a second-hand shovel, the repairs were a little higher than usual.

A Marion shovel with ¾-yard dipper is in use at the 1650-ft. level of the United Verde mine at Jerome, Arizona. The cost of loading ore into chutes with this shovel is estimated as being less than would be incurred by doing the same work by hand. The heavy weight of the machine makes it expensive to move in or out of a stope; and, on account of large capacity, it is idle often and waiting for ore. The advantage of the machine is that it loads material faster than some of the other types.



THEW UNDERGROUND MINING SHOVEL

Hoar Underground Shovel

The Hoar underground shovel (see page 130) consists of a dipper mounted on the forward end of the dipper-arm in three sections, a body, and a truck. The machine is operated by compressed air, three sets of air-engines being necessary to control the various movements. These air-engines are in the body. A turntable is placed between the body and the truck, which enables the machine to be swung through a complete circle. The truck runs on the ordinary mine-track. The standard-size machine requires an operating space of 7 ft. wide by 6 ft. high. Its weight is 5800 lb.; the air pressure required is 90 lb.; air connections are 1½-in. piping.

Operation. The Hoar underground loader is not self-propelling, and therefore must be pushed to its working place. It is then clamped to the rails. Having a full-circle swing, the machine can load cars to either side or to the rear. The operator has a seat on the small platform on the left-hand side of the body. He is well up above the machine and can observe the dipper in its various movements. The machine is controlled by three levers convenient to the operator. In digging, the dipper is forced into the pile of material by the forward motion given to the dipper-arm by its engine. At the same time another engine winds the cable onto the drum, which, acting as the lever, forces the dipper up through the pile. As soon as the dipper is raised free of the pile of material, the entire machine is revolved on the turntable until the dipper is brought over the top of the car; then the bottom of the dipper is tripped, allowing the material to discharge into the car.

RECORD OF PERFORMANCE. The Hoar underground shovel has been introduced in only a few mining districts. The manufacturers have found a ready market in the Lake Superior iron-mining district for their entire output, and little effort has been made to introduce the machine generally. It is being used in drifts, sub-leveling work, stoping, to clear out sumps, and also on the surface to shovel coal from the coal piles for use in boilers. The cost of operation varies considerably, depending upon conditions, and ranging from 17c. to $1.08 per ton.

In shoveling the material that was well broken and where there was plenty of room, an average of 135 tons was loaded in 24 hours at a cost of 17.9c. The wages of the attendants were: operator, $5 per day; helper, $4.75 per day. In another place where the material was wet and sticky and contained many large lumps, the machine loaded over 8500 tons in two months at a cost of $1.08 per ton. The mine manager estimated that to have done the same work by hand would have cost $1.60 per ton. The wages of attendants were: operator $8 and assistants $6 per day. In the case of sub-level stoping, the machine handled more than 1700 tons of material in one month at a cost of 65c. per ton.

MONTREAL MINE. In the latter part of 1920 a Hoar underground shovel was put in operation at the Montreal iron mine. At the same time similar work was being carried on by hand, so that it is possible to compare the cost of loading material by shovel and by hand. Comparison can be made between the work done on the 23rd and 24th levels. The driving was done in the hanging wall of both of these levels. The type of ground was almost the same, and the other conditions were also fairly equal. The 23rd-level drift was extended, using hand-loading alone. The cost for labor was $12 per foot over a period of seven months, and during this time the drift was advanced 469 ft., or at the rate of 67 ft. per month. In the 24th level, east drift, the Hoar underground shovel was used, and the drift was advanced 270 ft. in 3 months, or at an average of 90 ft. per month. The labor cost amounted to $6.62 per foot, and the repair and supply cost was $1.24 per foot, making a total of $7.86 per foot. At the same time the shovel was used to handle material on the 24th level, west, at a labor cost of $6.21 per foot, and a supply and repair cost of $1.24 per foot, making a total of $7.45. The saving in the east drift of the 24th level was $4.14 per foot, and the saving in handling the material from the 24th level was $4.55 per foot.

The following table will give briefly the comparison of this work:

Class of labor	Hand labor	No. 2 Hoar loading machine
Locality	23rd level	24th level
Material	Iron ore	Iron ore
Size of drift	10 by 10 ft.	10 by 10 ft.
Time of test	7 months	3 months
Total footage	469 ft.	270 ft.
Total tonnage	3906 tons	2250 tons
Monthly footage	67 ft.	90 ft.
Monthly tonnage	558 tons	750 tons

KEYSTONE EXCAVATOR

The Keystone Driller Co. has for several years manufactured and placed on the market an excavator usually used on road work and also in digging cellars and ditches. The machine consists of an upright boiler and an engine mounted on a tractor, also a dipper operating on a boom. The Federal Lead Co. purchased several of these machines and remodeled them to be used in its mine at Flat River, Missouri. In order to adapt the Keystone machine to underground mining, it was necessary to replace the boiler and engine by an electric motor.

OPERATION. The operation of the machine, as adapted by the Federal Lead Co., is as follows: The operator stands on the main platform where the movements of the dipper can be observed. By levers, the boom can be lowered and the dipper pulled into the pile of material by a cable operating over the pulley at the end of the boom. The boom can be lowered, raised, or swung by the second cable. As soon as the dipper is filled, the boom is raised and swung until the dipper is brought immediately above the car. The bottom is then tripped, allowing the material to discharge into the car. The machine is given stability by two braces on each side of the machine at the front.

RECORD OF PERFORMANCE, FEDERAL LEAD CO. During the year 1917, in mine No. 12, 48,917 tons of ore was shoveled by the Keystone excavator at a cost of 18.24c. per ton. In 1919, in mine No. 1, 8313 tons was shoveled at a cost of 19.11c. per ton, and for 1919, in mine No. 12, 318,819 tons was shoveled at a cost of 16.4c. per ton. In 1920, 370,373 tons was shoveled at a cost of 19.03c. per ton. This makes a total of 746,000 tons of ore shoveled by the Keystone shovel at the Federal Lead Co.'s mines, with an average cost of 17.85c. per ton. The distribution of these costs is as follows: tons of ore per shovel-shift, 126.1; supplies and repairs, 2.10c. per ton; maintenance labor, 12.57c. per ton; power, 1.35c. per ton; total, 17.85c. per ton.

GOLDEN ROD MINE. The Golden Rod Mining Co., at Tar River, Oklahoma, used a ⅝-cu. yd. Keystone shovel for loading ore. The shovel was operated for three or four months in 1918. The boiler was connected up as an air-receiver and the engine was run by compressed air. The ore was from 30 to 50 ft. high. In this work, the shovel did not prove satisfactory. It was mounted on a truck and was hard to move around. The main reason for its failure was due to the necessity of emptying the dipper into 1000-lb. cans; a large portion of the material was always spilled and had to be shoveled by hand.

SCRAPERS

The need for underground-loading devices led to attemps by many mining companies to develop and adapt a drag-scraper to load material. Several designs may be grouped under two heads: slushers and drags.

SLUSHERS. 'Slushers' is the name given a slip-scraper in the iron regions of Minnesota. The slip-scraper, after being filled with ore, is pulled by a 'Little Tugger' hoist. The scraper and cable are light enough so that the former can be pulled back by hand. It is also guided in its path by the helper as it is pulled by the hoist. The pull on the scraper is straight, but its path may be changed slightly by skilled manipulation.

DRAGS. 'Drags' are built in sizes to pull from 100 lb. to half a ton of material. The power is supplied by a hoist, which pulls the drag in a straight line toward it. The hoist also operates a tail-rope, which pulls the drag back over the pile. The tail-rope works over a pulley, which is attached at the end of the stope. By changing the position of the pulley the line of the drag can be changed.

SLUSHERS AT OLIVER MINE. 'Slushers' are used in the Oliver mine to load iron ore into cars, and also in chutes in sub-level stoping. The 'Little Tugger' hoist is mounted on an upright or horizontal bar that is back in the drift; quarter-inch extra-flexible tiller-rope is used to pull the scraper. Two men are required to operate the scraper and load the cars; one man operates the hoist and the other loads the scraper. The scraper is pushed into the pile by hand and pulled by the 'Little Tugger' hoist. In this way the scraper is filled. It is guided along its path and up the platform by a miner who dumps it into the car.

Most of the scrapers of this type in use have a solid yoke for a bridle, consequently the scraper can penetrate only a certain distance into the pile. This is beneficial in a pile containing large pieces of rock, but it is not advisable with fine dirt. The bridle can be made flexible by attaching it to the side of the scraper and near the handle; this makes it possible for the person operating the scraper to dig deeply into the pile and so obtain a maximum load of material.

In top-slicing work by the Oliver Iron Mining Co., in Minnesota, the material is dragged into a chute. By the use of the scrapers in stopes, the company accomplishes more than twice the work with the same number of men. This, of course, is an item, but the main advantage of the scraper is the speed with which the work is accomplished.

JUNCTION MINE. A drag has been in operation at the Junction mine of the Calumet & Arizona Mining Co. for many years. The ore is broken down upon the floor, which is inclined in the direction of the movement of the ore. At the Junction mine the ore occurs in lenses in limestone. Most of the ore is mined by the cut-and-fill method. Cuts are run on an inclination and the ore usually runs to the chutes without shoveling. The drag is used for pulling the ore where the floor is too flat for it to run. A 'Little Tugger' hoist with endless cable operates the drag both ways.

O. M. BILHARZ MINING CO. The O. M. Bilharz company, at Miami, Oklahoma, has developed a scraper at the Shorthorn mine that is efficient; by so doing it has lowered the loading costs. This has been done in spite of the fact that the Joplin miners have a record for shoveling efficiency that is considered marvelous in most mining districts.

At the Shorthorn mine several drags are being used to load ore into the cans. A hoist is set up on a platform. There is an incline from the platform to the floor of the stope. In front of the hoist is a hole a little smaller than the opening in the can. The truck carrying the can is run underneath the platform, there being a clearance of several inches between the bottom of the platform and the can. The drag brings a load of material up the incline upon the platform, discharging it into the can through the opening. The hoist is then reversed, the drag is pulled back, and the operation is repeated. In this mine the ore is being dragged as far as 200 ft.—an unusual distance. A cable is stretched across the far end of the stope, and a block is arranged on the cable so that by changing the position of the block the path of the scraper can be changed from one side of the stope to the other. The manager states that the cost of loading the ore with a drag is 16c. per ton.

OHIOMO MINING CO. The Ohiomo Mining Co. has a drag system for loading ore at its mine at Picher, Oklahoma, which appears to be successful. Almost all the ore hoisted is loaded by means of six drags. The mine is a new one, with an orebody about 30 ft. thick. In opening a working place a drift is run in the bottom of the ore from the shaft to a desired point, a raise is put up to the top of the ore, and a hopper is built. A cut is then started along the top of the orebody; when the broken material will no longer run into the hopper, the drag is used.

An electric hoist is installed on the platform over the chute; the two drums being driven by a 5½-hp. motor in opposite directions and from the same gear-wheel; a half-inch steel cable is run through a sheave-wheel at the face of the stope, each end being wound on a drum. The sheave-wheel is mounted on a traveler, which can be moved from side to side along a cable anchored across the face of the chamber. The steel drag is heavy enough to dig into the broken ore and fill itself. The hoist pulls the loaded drag until the ore is discharged into the hopper. The hoist is then reversed and the operation is repeated. The hoist is operated by one man, who also breaks boulders. The cable at the face has to be moved forward every time the heading is extended. One man by this method has loaded as many as 266 cans in eight hours. The output is generally limited to the amount of ore broken. One man can drag ore faster than four machine-drillers can break it.

QUINCY MINE. The Quincy Mining Co., at Hancock, Michigan, first started to use drag-line scrapers in its drifts and stopes in the fall of 1915. The orebody is 6 to 10 ft. wide and dips about 36°. At first the company had difficulty in getting a hoist that would be light enough, small enough, and, at the same time, strong enough to handle a drag-line scraper of sufficient size to be economical. To solve this problem, a specially-designed scraper-hoist was manufactured for it by the Lake Shore Engine Works, at Marquette, Michigan. It is a small compressed-air hoist with two 6 by 9-in. cylinders. It has a double drum, 14 in. diameter, and will maintain a rope speed of 300 ft. per minute. At first a scraper was designed with heavy rugged teeth, but later, the teeth were replaced by a steel shoe, because the large rocks pulled out the teeth. A scraper was then designed which was 30 in. wide and had a curved shape somewhat similar to a hoe. This scraper was used both in stoping and drifting operations. Later it was replaced by a scraper 40 in. wide. The great advantage of using scrapers at the Quincy mine was that they could advance 50% faster than was possible when doing the work by hand. There was also a reduction in cost.

Mohawk Mine. The Mohawk Mining Co., at Mohawk, Michigan, has seven drag-line scrapers. Six of them have hoists with two 6 by 6-in. cylinders and 12-in. drums, and the seventh has two 8 by 8-in. cylinders, with a 20-in. drum. A rope-speed of about 222 ft. per minute is maintained. The scrapers are the same as those used by the Quincy Mining Co. The wages of the men range from $3.60 to $4 per day; the company loaded 8000 tons in three months at a cost of 17½c. per ton.

Calumet & Hecla Mining Co. The Calumet & Hecla Mining Co., at Calumet, Michigan, tried drag-line scrapers in the fall of 1920. The scraper was patterned after the scrapers used in the Missouri zinc-fields, differing slightly in size, shape, and method of operation. The scraper weighs complete about 600 lb. It takes from 4 to 8 scraper-loads to fill a 50-cu. ft. car. The hoist was designed for a rope-speed of 300 ft. per minute, dragging a scraper with a load of 1800 lb. The company had on hand a number of small hoists, known as 'Tamarack' hoists, that were originally used in its rope-haulage system. These hoists had two 6 by 6-in. upright cylinders, driving two 8-in. drums on a 4-in. shaft by friction-clutches. It was soon found that the friction-clutch would not handle the load, and that the 8-in. drum would not give the required rope-speed of 300 ft. per minute. Friction-clutches were abandoned, and later the hoists were equipped with gear-clutches and 10 or 12-in. drums. Under exceptionally favorable circumstances, two men have loaded and trammed to the motor drift 93 tons in one shift. The cost of labor varied from $3.60 to $4.10 per shift. The cost of loading material from this scraper varies from 10 to 24c. per ton.

The study of underground loading devices is being continued by K. Baumgarten, mining engineer, who is connected with the St. Louis Station of the U. S. Bureau of Mines.

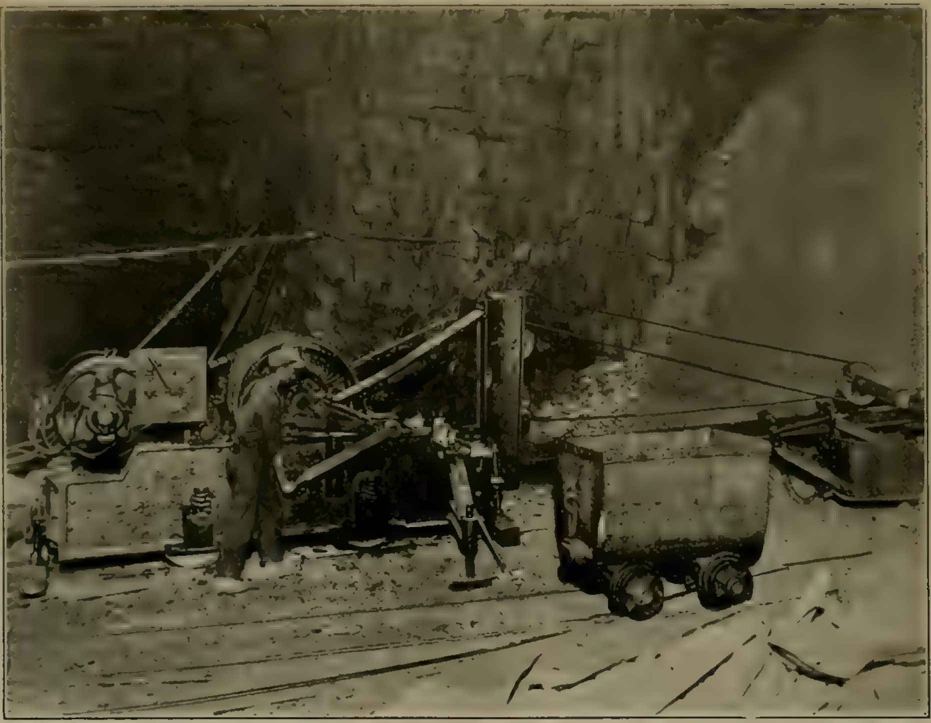
In view of the project to re-open the old copper mines in the mainland of the Shetland Islands, a recent report by Dr. J. S. Flett, director of the Geological Survey for Scotland, is of timely interest, states 'The Mining Magazine'. The deposits are found in the Old Red Sandstone of the Devonian Age, and extend from Rovey Head, north of Lerwick, along the eastern side to the extreme south of the mainland. Pyrite and chalcopyrite have been worked for copper at several places; the most important deposit is at Sandlodge, 14 miles south of Lerwick, where the main lode, consisting largely of siderite, is 9 or 10 ft. wide. This deposit was first worked at the end of the 18th century, but active development was not undertaken until 1872, and during the period 1872-1880 about 10.000 tons of iron and copper ore was raised. In 1880 the yield was 1995 tons of ore, valued at £5814, and 396 tons of iron ore, valued at £344. Copper pyrite is known to exist at a number of other places, but Dr. Flett does not regard successful exploitation as at all profitable. At the Sandlodge mine there is a possibility of success if modern methods of mining and dressing be used.

A State-controlled platinum trust has been organized by the soviet government, which will have charge of all the platinum prospecting and mining business in Siberia, as well as the platinum smelting and refining works near Petrograd, Moscow, and Ekaterinburg, states a consular report. This trust will act as the central sales agency for both foreign and domestic trade, and will thus be in a position to regulate the prices of platinum in the international market. The following statistics have been compiled from reports, published from time to time in the official soviet publication 'Economic Life', covering the production for 1921 up to August:

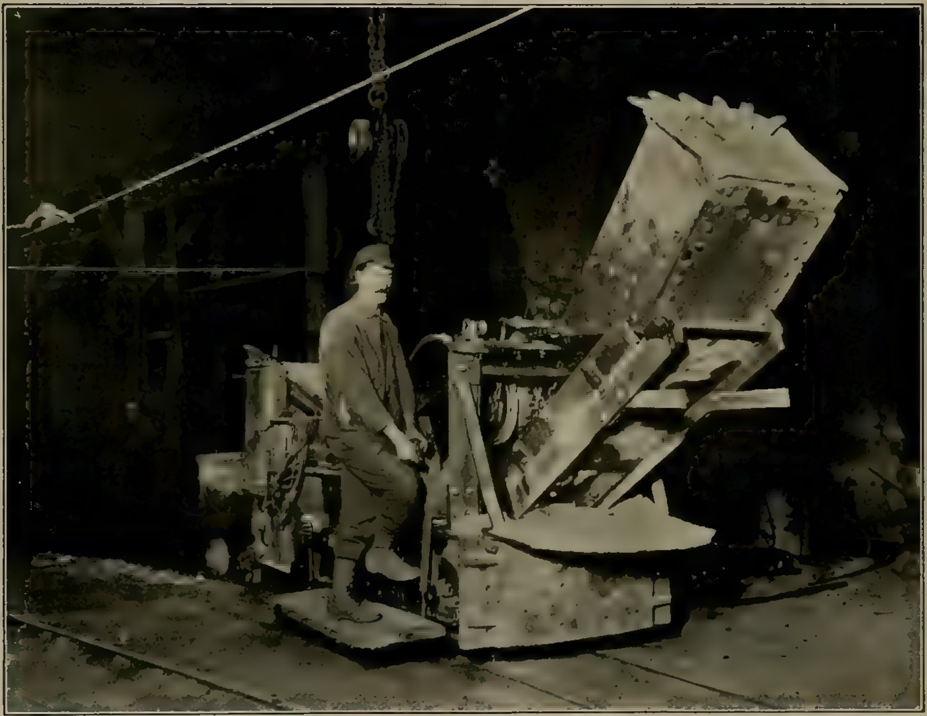
	Poods	Russian pounds	Zolotniks	Dolias
January to April	.	31	23	76
May	1	6	85	48
June	4	14	62	8
July	2	5	11	..
August	3	1	41	84
Total	11	19	32	24

Note: One pood is equivalent to 40 Russian pounds; a Russian pound = 96 zolotniks; a zolotnik = 96 dolias. One Russian pood = 526.6637 troy ounces; 1 Russian pound = 13.1666 troy ounces.

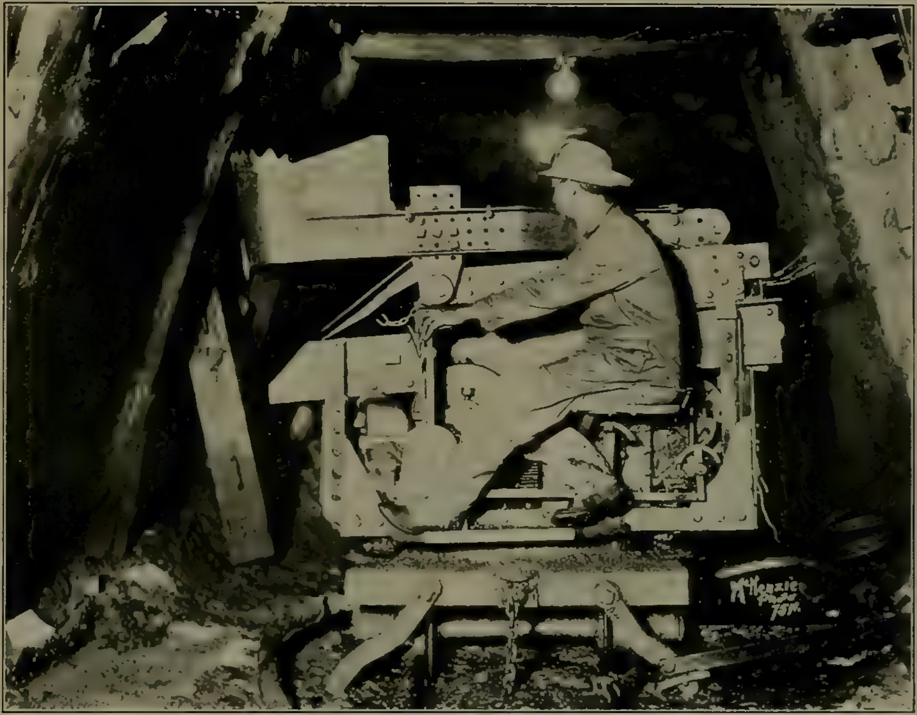
The above total is thus equal to 6047.8 oz. The annual average production for five years prior to 1914 was 172,000 oz. After the beginning of the War the output of Russia's platinum mines showed a steady decline, production coming to a complete standstill about the middle of 1918. Production in 1914 amounted to 157,000 oz.; in 1915, to 108,000 oz.; in 1916, to 79,000 oz.; in 1917, to 98,000 oz.; and for the first six months of 1918 it reached only 13,000 oz. The United States consumes ordinarily about one-half of the world's platinum production; of this output Russia, in normal years, furnished more than 90%. It is now an important element in the manufacture of sulphuric and nitric acid, electric furnaces, contacts for telephone, telegraph, and wireless systems, aeroplane engines, scientific and surgical instruments, etc. The dental industry and chemical laboratories also require a large amount of platinum, and lately a strong demand has developed in the manufacture of jewelry.



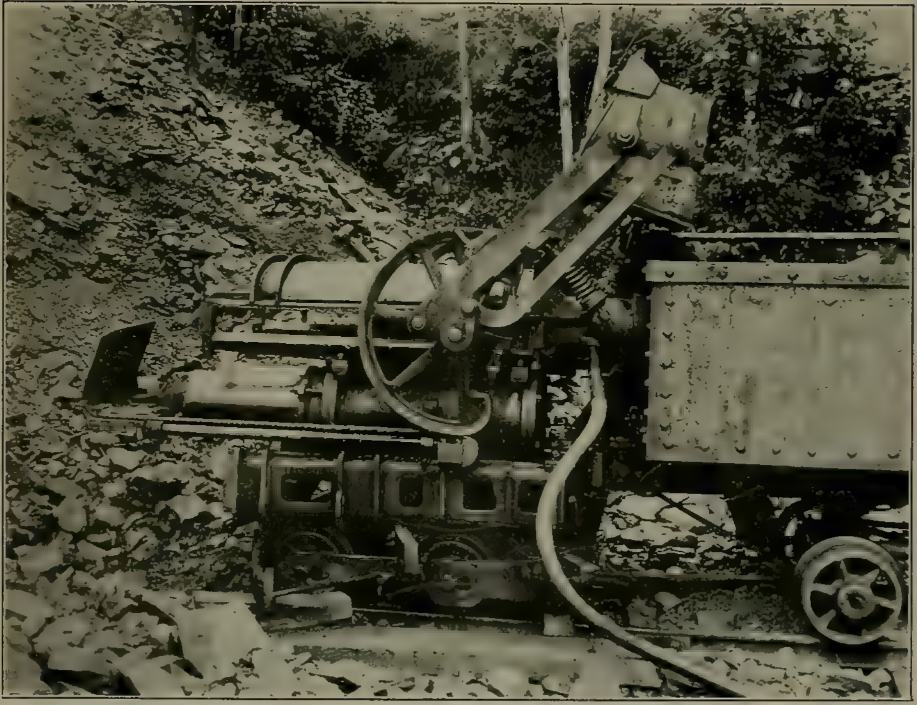
THE CONWEIGH SHOVEL-LOADER



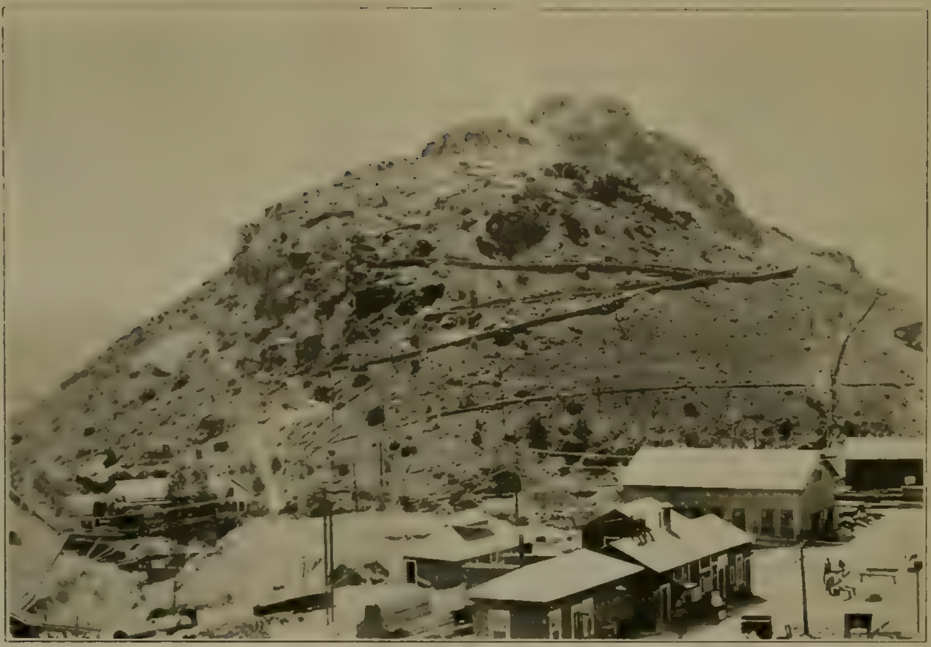
THE CONWEIGH DIGGER BELT-LOADER



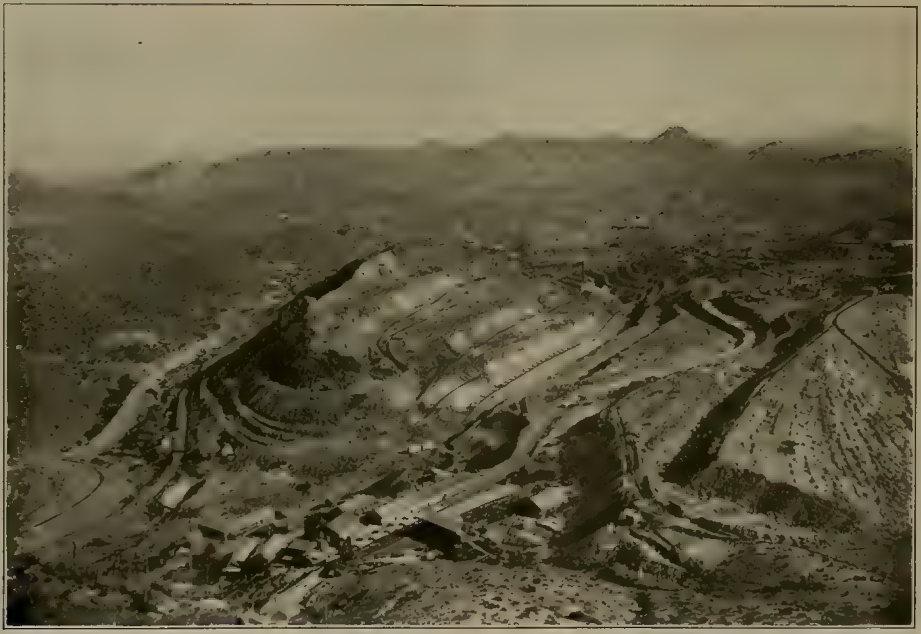
THE HOAR UNDERGROUND SHOVEL



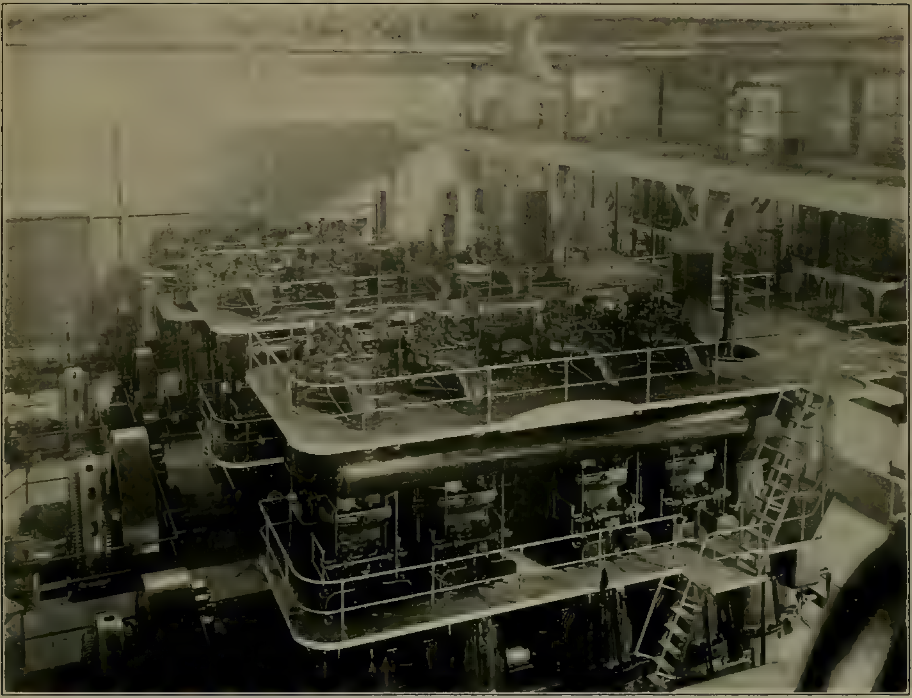
THE 'SHUVELODER'



SACRAMENTO HILL, BISBEE, BEFORE STRIPPING OPERATIONS WERE COMMENCED



SACRAMENTO HILL, AS IT APPEARS TODAY



DIESEL-ENGINE PLANT AT THE COPPER QUEEN CONCENTRATOR NEAR BISBEE

VIEW OF THE DIESEL-ENGINE POWER-PLANT

REVIEW OF MINING

RE-ENTRY OF LEAD BULLION TO COUNTRY OF ORIGIN

The North-West Mining Association recently passed a resolution in support of the proposal to secure a reciprocal agreement between Canada and the United States, providing that lead bullion derived from ores shipped across the international line, either way, may be returned free of duty to the country of origin. It was maintained that such agreement would not in any way interfere with the lead schedules provided for in the Fordney tariff bill now before Congress and by which import duties of 2½c. per pound upon lead bullion and 1½c. per pound upon lead in ore of foreign origin are provided. The adoption of such reciprocal agreement with Canada would provide alternative smelting outlets for ore from districts adjacent to the international line in British Columbia and Washington, thus promising more uninterrupted development and greater prosperity in both.

BRITISH COLUMBIA PROSPECTORS' ASSOCIATION ELECTS OFFICERS

At the recently held annual meeting of the British Columbia's Prospectors' Protective Association, officers were elected as follows: honorary president, Hon. Wm. Sloan; president, J. W. Mulholland; vice-president, J. C. Riley; secretary, F. A. Starkey; treasurer, R. J. Elliott; executive committee, W. W. Moore, J. Rodway, and J. P. Sherran. An outline of the achivements of the association during 1920 was given by Mr. Mulholland, after which it was decided to urge the Dominion government to establish a plant for the experimental treatment of the complex ores of the Kootenay, and to petition the Provincial government to take over the Granite Poorman mill, or some similar plant, and operate it for the benefit of small property owners, giving advance payments on shipments in order that development might proceed. It was pointed out in this connection that there are in eastern British Columbia a large number of properties that could be operated on such a basis.

SECRETARY HOOVER OUTLINES COLORADO RIVER PLAN

Secretary of Commerce Hoover, as chairman of the Colorado River Interstate Commission, has outlined the policy he will advise and pursue for the promotion of the Boulder Dam project and the reclamation of arid land.

Secretary Hoover has informed Congressman Swing that the Colorado River Commission should supervise construction; he is convinced that the work should be done by the Government. He intimated that there might be three agencies in the construction machinery, the Colorado River Commission to have general supervisory powers, recommending successive steps in the improvement of the river, which would eventually result in its complete utilization, actual construction to be done by the U. S. Reclamation Service. It is possible that an advisory board of engineers will be selected by the commission to pass upon proposed plans and to give their expert advice. Delay in the approval of the Davis report on a general survey of the Colorado River reclamation project has caused attendant delay in actual framing of the bill to be submitted to Congress for governmental action. Congressman Swing protested to Secretary Hoover against the report that Davis considered "the States of Arizona and Nevada, in which this great reservoir site lies, should each be granted a block of free power perpetually in lieu of the taxes that would be collected upon the property if it were erected by private enterprise". Congressman Swing considers the two States entitled to no such special privilege.

SLIGHT IMPROVEMENT IN MEXICAN CONDITIONS

Conditions in Mexico are slightly improved, although the industrial depression continues and unemployment is increasing slightly, according to a report received by the United States Department of Commerce. The banking situation is not much better, with difficult collections and gold hoarding on the increase. The bank interest averages 18%, loan money is tight; gold is easier at 48⅜. The gold stock is estimated at ₱100,000,000, of which ₱45,000,000 is in banks, ₱30,000,000 is circulating, and ₱25,000,000 is hoarded.

Little change is noted in foreign trade, but freight congestion at ports and on railways has been alleviated, consequently the roads are looking for business. Freight-rates on imports entering through Juarez have been reduced from 15 to 40%. November oil production was valued at approximately ₱4,500,000.

NIPISSING OUTPUT IN 1921

During 1921, Nipissing produced approximately 3,097,000 oz. silver, an increase of 286,000 oz. over the 1920 production, and comparing with 3,080,069 oz. in 1919. Last year's output was the largest since 1918, when 4,116,000 oz. was produced. As showing the extent to which production was increased during the last quarter of 1921 in order to take advantage of the higher silver prices, it is interesting to note that October, November, and December accounted for 1,065,000 oz., or 34% of the entire year's production. Last April, Nipissing reduced its dividend from 5% to 3%, due to low silver prices and high labor costs. At that time silver was about 57½c. per ounce, since which time there has been a substantial advance, culminating in the high prices of last October. The net value of silver to Nipissing in May was 58½c. per ounce. By August it had increased to 65c., thence to 70c. in September. The November average was down to 66¼c., whereas that for December was lower still. The estimated value of ore produced by Nipissing last year was $2,184,467, comparing with $2,550,000 in 1920, $3,117,000 in 1919, and $3,544,000 in 1918.

COPPER SHIPMENTS TO GERMANY DURING 1921

Over 200,000,000 lb. of American copper was shipped to Germany during 1921, an amount far exceeding the exports to any other country and an amount representing more than 33% of the outward-bound shipments. The business represented cash payments of more than $30,000,000, states the 'Boston News Bureau'.

Total copper exports for the first 11 months of 1921 were 566,928,506 lb., against 581,885,109 lb. in 1920 and 476,322,109 lb. two years ago. France and England have fallen far behind their records of the years immediately preceding. Japanese buying during the past year was not up to that of

1919. Eleven months' consignments were 47,410,544 lb., in comparison with 82,913,730 lb. in 1920 and 62,803,603 lb. in 1919.

EL ORO MINING & RAILWAY CO. CONSIDERS METHOD TO EVADE DOUBLE TAXATION

At the annual meeting of the El Oro Mining & Railway Co., recently held in London, R. T. Bayliss, the chairman, said: "For the year ending June 30, 1921, we earned from all sources, and before deduction for taxation, a profit of £221,311. The amount we had to deduct therefrom for payment of taxes in Mexico, and the provision it was necessary to make for income and corporation profits tax in England on what was left amounted together to £146,927, representing slightly over 66% of the total profit earned. This leaves us with a net profit for the period of £74,383 3s. 6d., as shown in the balance-sheet. For companies such as ours, operating abroad and domiciled in England, this burden of double taxation is very severe; and if it is to continue, as I fear it must, the whole question will furnish cause for careful consideration as to whether we should not remove the company beyond the jurisdiction of the income-tax authorities."

HOMESTAKE COMPANY OPPOSES IMPORT DUTY ON CYANIDE

Opposition to import duties, on cyanide salts, mixtures, and compounds, of 33⅓% ad valorem or 7c. per pound was made by the Homestake Mining Co., of Lead, South Dakota, supported by Senator Sterling of that State and also by the American Cyanamid Co. of New York. Opposition was based on the fact that such a levy would increase the price of these products, which are used in extracting gold and silver from ore.

The hearing before the Senate Finance Committee was marked by charges that mining interests had been dependent on a monopoly held by the Roessler company. Senator Sterling charged that the company exercised a monopoly, and opposed the duty on the ground that American mining interests had contracted for cyanide with American producers in Canada. He read a letter from A. L. Alberson, a metallurgist, to the effect that German producers referred American purchasers to the Roessler company. Senator Sterling charged that there was an agreement between the Roessler company and German and English manufacturers to control the market. The Homestake company was making 900% profit per year, the gold-mining industry was in a condition of collapse. It gave a chart showing the decline in gold production from 1907 to to 1920, and stated that 40% of gold-mine operations in this country had suspended during the last few years; and that gold mining in the Black Hills of South Dakota was in a state of disintegration, not because the mines are becoming exhausted but because the gold does not have sufficient value to pay the cost of production. It was said the increased cost of gold production was largely due to the cost of materials in such production, chief among which were cyanide compounds. It said the duty would add 1.6c. per ton to gold-mining costs, or $25,000 per year to the Homestake company. The company says cyanide prices paid the Roessler company increased from 14½c. per pound in 1914 to 30c. per pound in 1918, with a reduction to 21½c. per pound in 1920, but an increase to 24½c. per pound in 1921. The Homestake company refused the Roessler products in 1921, purchasing from the American Cyanamid Co. at a lower rate. The company said it consumed annually 175 tons or 350,000 lb. of sodium cyanide. The representative of the Homestake company spoke at length of the value of cyanide in mining. Until 1917, when the American Cyanamid Co. undertook production of cyanide, the mining industry was at the mercy of a foreign corporation. He said, in 1921 the Nevada Mine Operators' Association purchased cyanide from the American Cyanamid Co. at 23¾c. per pound as against 28½c. asked by the Roessler company. He estimated that the gold industry of the United States in 1920 saved $100,000 by purchasing from the American Cyanamid Company.

DECREASED GOLD IMPORTS

Imports of gold during December were the lowest for any month during the past year, aggregating $32,000,000, as compared with $51,000,000 in November and $45,000,000 in December 1920, and exports during the month aggregated $2,000,000 as compared with $606,000 in November and $17,000,000 in December 1920, according to the Department of Commerce.

Imports of silver in 1921 totaled $63,000,000, compared with $88,000,000 in 1920, and exports of the white metal amounted to $52,000,000, against $114,000,000. During December silver imports aggregated $6,000,000, as compared with $7,000,000 in November and $5,000,000 in December 1920, and exports totaled $8,000,000, as compared with $5,000,000 in November and $6,000,000 in December 1920.

SURPLUS STOCKS OF ZINC AGAIN REDUCED

Surplus stocks of zinc in this country were further reduced in December. Total production amounted to 22,013 tons; shipments totaled 22,454 tons, a reduction in surplus of 441 tons. On December 1 surplus stocks stood at 67,049 tons, and on the first of the current month they amounted to 66,080 tons. On July 1 of last year surplus stocks amounted to 89,062 tons, the largest tonnage of metal on hand at any one time in the history of the industry. In six months, therefore, there has been a reduction of virtually 25,000 tons.

The improvement in the zinc situation is all the more noteworthy when it is remembered that, for the first eight or nine months of this year, production averaged between 14,000 and 15,000 tons monthly. Production in the last few months of 1921 had increased 50%, yet at the same time surplus stocks were reduced over 30% from their high mark.

NEW CORNELIA COMPANY RESUMES DIVIDENDS

The directors of the New Cornelia Copper Co. have declared a dividend of 25 cents per share, payable on February 20, to stockholders of record February 3. The last dividend paid was 25c. in July 1920. At the close of that year the company had copper on hand valued at over $4,500,000, at 12½c. per pound. This surplus has doubtless been liquidated during the past year so that the company is now in a strong cash position. The company has a total of 1,800,000 shares outstanding of $5 par value, of which Calumet & Arizona owns nearly 70%. The company last year produced 21,150,000 lb. of copper. Although commercial production was suspended on April 1 in unison with other leading mines, the company had to keep a small but steady flow of copper through its reduction works in order to preserve them in good condition. A considerable amount of New Cornelia's 1921 production was sold, but the company still has enough copper on hand to get the benefit of any rising quotations during the next few weeks.

Exclusive of unsold metal net quick assets at the close of last year were $4,800,000. New Cornelia can resume maximum operations quickly. It can double its current production of 21,000,000 lb. per year. The company has demonstrated that it can produce copper as cheaply as can the other leading mines of the country.

ARIZONA

Globe.—The first United States patent to asbestos claims to be recorded in Gila county has been filed by the Arizona Asbestos Association. Twenty-one claims were patented.

——The Arizona Asbestos Clearing House has been organized with headquarters at Globe, to handle the minor asbestos production of the district; it will be under the management of experienced asbestos men, and it is the intention of the concern to serve the smaller claim-owners by purchasing small shipments. The asbestos so purchased will be graded and sold in the Eastern markets.

Kingman.—It is announced that the McCracken mine, 36 miles south-east of Yucca, has been taken over from F. A. Garbutt by L. D. Adams. The purchase price is said to be about half a million dollars. The property will be operated by L. D. Adams and J. C. Bucher, who represent a Canadian corporation. The new company proposes to equip the mine immediately for a production of 150 tons per day. The McCracken mine was discovered in 1874 and has produced over $4,000,000 in silver from the upper workings.——It is reported that a strike of high-grade ore running 250 oz. silver has been made on the level 30 ft. above the tunnel of the Dean mine. The ore at this point is said to be 54 in. wide and was opened to the west of a fault through which a drift had been carried for a distance of 30 ft., the ore being found in a short cross-cut. The mill is operating steadily; 80 tons of high-grade silver concentrate is being shipped to the smelter each month. It is expected that the addition now being made to the mill will bring the capacity up to 150 tons per day.

Miami.—J. Carolan, M. McAuliffe, and associates have bonded their Spring Creek properties in Pleasant valley, 75 miles north of Globe, to Denver interests. The purchase price is said to be $125,000.——It is announced that the Cactus mine is to be opened in the near future and a large force of men are to be engaged. It is understood that G. H. Drummond of the Superior & Boston, who represent interests in control of the Cactus, will have charge of operations. The mine, which is on Pinto creek a few miles west of Miami, has been closed-down for 12 years.

COLORADO

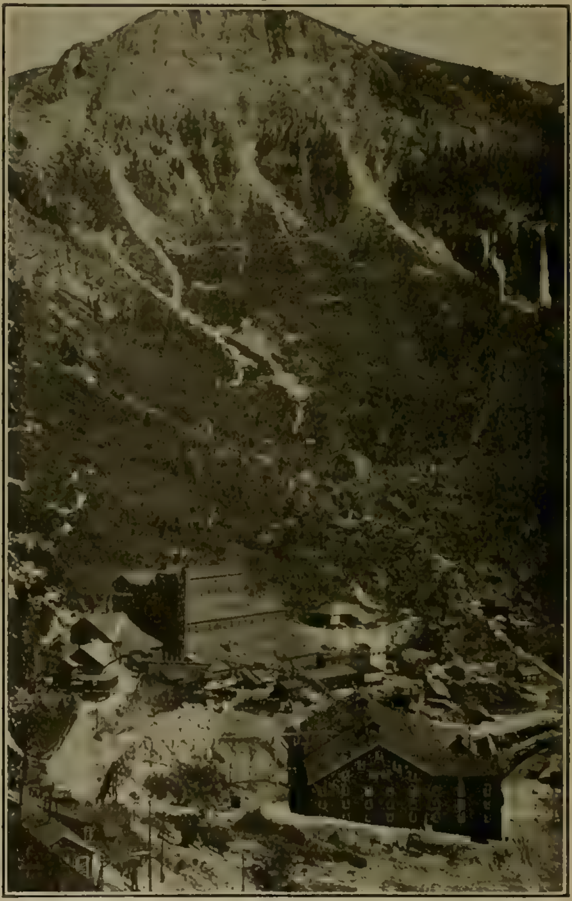
Blackhawk.—Smelter returns on a carload shipment to the Arkansas Valley smelter, Leadville, by the Silver Mountain Mining Co., showed $5.89 gold, $56.07 silver, $3.52 lead, a total of $65.48 per ton. The net return was $1012.44. A new stope has been started at 260 ft., on the Black Jack vein, and 20 tons was sent to the Leadville smelter.

Creede.—Road conditions are delaying shipments, but three leased properties were shipping last week. The Ethel lease on the Solomon group shipped a carload to the Arkansas Valley smelter, Leadville; Morgan and Sloan, of the New York property, sent a car of high-grade ore to the Durango smelter.

Cripple Creek.—The Cresson continues to make large shipments of ore averaging between $12 and $15 per ton. ——A new company, the Cripple Creek Gold Bond Mining Co., organized to take over the holdings of the Gold Bond Consolidated company's holdings, has commenced operations and has shipped two carloads of ore from a clean-up of the old workings. One car netted $11.80, the second car $32.75 per ton.——Gold ore, sampling from 2 to 16 oz. per ton, has been opened up in a 3-ft. vein at the 300-ft. level of the Dig Gold Mining Co.'s property on the southern slope of Gold hill. The property is operated by the Dig Gold Leasing Co., composed of stockholders of the owning corporation.

Ouray.—Machinery and equipment has been purchased in California for the Welch-Worland Mines Syndicate, operating the property formerly owned by the Wanakah Mining Co. Tests on the ores are being conducted. Ore is being held in reserve until the mill is ready to resume treatment. ——The Chipeta M. M. & S. Co. continues development of the H. A. C. mine. Drifting is in progress, and a long cross-cut will prospect virgin territory.——Lessees on the upper workings of the Guadaloupe are in receipt of $1000 from a carload shipment. Another shipment goes forward this week.

Silverton.—A syndicate, headed by State Senator John H. Slattery, has taken a long-time lease on the Mayflower; new machinery is being installed. A former lease in which Senator Slattery was interested is reported to have netted the operators in excess of $300,000.——The Melville Mining & Leasing Co. has been organized locally to take over the properties of the Iowa-Tiger Mining & Milling Co., succeeding the South-Western Leasing Co. The new company will operate both mine and mill.



Smuggler-Union Mill, Telluride, Colorado

IDAHO

Kellogg.—Five feet of carbonate ore, principally lead oxide, has been uncovered in the drift on the 300-ft. level of the Lookout mountain property, situated near Kellogg. This marks the third consecutive shoot of ore found on this level. The drift has passed through 68 ft. of ore, averaging better than 6 ft. wide, and has now entered a second shoot of oxides. Cross-cuts on the vein at this point have been extended 34 ft. without reaching either wall. The ore exposed contains 50% lead and 40 oz. silver. The property shows a large tonnage of commercial ore, available for shipment to the Bunker Hill smelter; as soon as a 2000-ft. tramway can be built shipments will start. The company has withdrawn the sale of treasury stock from the market and will finance further development work from ore shipments. Ore shipments to the smelter will be made by auto-truck, a distance of eight miles.

The Star Mining Co. has distributed a dividend of $250,000 in accordance with a declaration recently made. The disbursement was at the rate of 25c. per share. The property of the Star company has passed into the possession of the Bunker Hill & Sullivan Mining & Concentrating Co., who sold a half interest to the Hecla Mining Co. A tunnel 8000 ft. long is being driven from a deep horizon of the Hecla to the Star.

According to M. H. Sullivan, general manager of the Bunker Hill smelter at Kellogg, in future the smelter will be able to refund the duty of ¾c. per pound to Canadian shippers, which hitherto has been held out of settlements. On ore containing 50% lead this will be an increase of $7.50 per ton in the returns they will get from the smelter. Another furnace was blown-in several weeks ago, now making two in operation. A customs inspector of Eastport has been overseeing the weighing and sealing of 200 tons of lead at the Bunker Hill smelter which was derived from British Columbia ore and shipped to Kellogg in bond. The lead has been shipped to Portland, where it will be loaded for transportation to France.

Three shifts daily are now employed at the Sunshine Mining Co. on Big creek, in the Coeur d'Alene. After being closed two months operations were resumed. This is one of the newest mining ventures in the Coeur d'Alene to be brought to a successful consummation. The company was organized a year ago by E. C. Tousley, a Spokane mining engineer.

The Boulder Creek Mining Co., in which John Peter and Thomas King of Sandpoint are large shareholders, has purchased machinery for the erection of a mill on its property 20 miles north of Sandpoint on Boulder creek. The company has driven a tunnel, now 130 ft., on a vein which has increased from 3 to 6 ft. in width in the last few months. A recent assay of this ore went $48 per ton. Machinery will be installed as soon as weather permits. All development work has been done by the owners and no stock is for sale.

MICHIGAN

Houghton.—Calumet & Hecla and subsidiaries, Isle Royale, Ahmeek, and Allouez will resume production on April 1. The majority of the men being taken on are timbermen, for the major part of the work preliminary to re-opening consists of repairing shafts. More work will have to be done in the conglomerate zones of Calumet & Hecla than in the amygdaloid zones, because the earth movement has occurred there. A few of the hoists on the conglomerate zone are being placed in commission, and more will be employed as the work of timbering extends to other shafts. Timbering is now in progress in No. 2, 4, 5, and 6, Calumet branch, 6 and 7, Hecla branch, and in the Red Jacket shaft; the hoists at these shafts are in commission. All hoists on the conglomerate zone are in good condition; during the period of idleness they were turned over each week to ensure against defects from lack of use. The Osceola-lode hoists were the only ones dismantled. The Calumet & Hecla plant, which in 1920 produced over 1,000,000 lb. of refined copper per month, will not be re-opened on April 1. On a return of normal conditions, work on the proposed reclamation plant on the Tamarack conglomerate sands probably will be undertaken next summer. No date has yet been considered for the re-opening of the Osceola and Centennial properties.

Copper Range continues to take on men at its three mines, principally at Champion. The program of mining and opening work has been increased at both the Champion and Baltic; developments in Champion are satisfactory. Sinking and drifting are under way in both of these mines; a program of development continues at Trimountain. Champion is opening good ground, averaging 39 lb. of refined copper per ton; Trimountain holds its improvement, and is averaging 30 lb. per ton. Baltic ground is running about 34 lb. Champion production now is 80% of normal, Trimountain 65%, and Baltic 80%. Copper Range metal sales have not kept pace with production, and the company now has between 8,000,000 and 9,000,000 lb. copper on hand, equal to about three months' production.

At Mohawk, sinking is in progress in No. 1, 4, and 6 shafts, in addition to drifting. The property continues to work to the capacity of its milling facilities, shipping about 2600 tons per day. Mohawk is in position to benefit considerably by an increase in the price of copper, for its force has been normal for upward of a year and the small labor-turnover has made for efficiency. The vein in the lower levels is not being mined for the full width. This will permit a return to the older workings in years to come.

Work in the Seneca property is continuing. The construction of a new hoisting-plant and boiler-house, the installation of the new hoist and the extension of the Mineral Range railroad to the shaft are yet to be undertaken; so it will be late spring before it will be possible to resume sinking. The third-level drift from Seneca toward the Gratiot property is now in over 2000 ft., with approximately 1500 ft. more to go. There is good milling ground for almost the entire length of this drift; the fourth-, fifth-, and sixth-level drifts toward Gratiot are well mineralized. The seventh or bottom level is in good ground both north and south, the vein showing uniformity in copper content with depth.

Six furnaces are in operation at the Calumet & Hecla smelter. Cupola blocks constitute about the only material left to refine, although it is believed there is enough of these, and cathodes from the electrolytic plant, to keep several furnaces in commission until the mines re-open.

MISSOURI

Carthage.—A total of 381,000 tons of lead and zinc ore was produced in the Missouri-Kansas-Oklahoma field in 1921, the lowest tonnage production since 1915 and the lowest valuation since 1903, the price received for the 1921 ore being $10,749,427. In 1903 the total value was $9,471,390. The total output of zinc ore was 313,002 tons, the lowest since 1914 when it was 309,538. The value of the 1921 zinc ore was $7,199,949, the lowest in 20 years. In 1901 the zinc ore produced in the district brought $6,353,950. The lead-ore production was 68,006 tons, valued at $4,289,838, which has been exceeded in only two years in the history of the field—1919 and 1920—and exceeded in value only by the annual production of each of the last five years. Low prices were responsible for the slump in production, a big portion of the mines being forced to shut-down. Recently ore prices have been improved and more mines have opened up, with indications of continued increased production.

Oronogo.—Plans are being laid to open the Oronogo Circle mine in this city, and two 10-hr. shifts will be maintained. This is the largest mine in the Tri-State district and represents a valuation investment of more than a million dollars. It is owned by the Connecticut Lead & Zinc Co. and will be under the management of A. J. Burnham. The plant has a capacity of 3000 tons per 24 hours, and when working full time employs 75 men. The mine has been closed since last October and the management has had a force of men employed doing the preliminary work necessary to get the shaft repaired. One of the jobs was to shoot away large pillars underground, thus letting down surface soil that had been previously removed to a point where it could be dragged to the big shafts. Seven electric drags are to be used and underground crushers have been put in place to reduce all rock to a size that can be handled on belt-conveyors, which carry it from the hoppers to the mill, into which it is automatically dumped. The surface ore from about 11 acres of the ground was scraped back by the company some time ago, preparatory to shooting the underground pillars and dropping the mass to where it could be handled. In the walls of the cave, pockets and veins of lead ore are found. While the mill has not been in operation the company has permitted prospectors to take ore from the ground at a 33⅓% royalty. The cave has proved a rich field for 'gougers', who have searched the walls by paths along the ledges and by lowering wires or ladders to points they could not reach otherwise. These miners use nothing but a pick and buckets. In the more accessible places, hand-jigs are used. One side of the cave is honey-combed with dug-outs and entrances to prospects.

NEVADA

Ely.—The Nevada Consolidated Copper Co. plans to resume operations in the Ely district within a few weeks, according to advices received. It is reported that the company will operate at about 60% of its normal capacity and devote particular attention to the deposits opened several months ago in the Ruth mine, and the copper pits on the main deposit. All surplus copper at the McGill smelter was shipped last year and the plant is in readiness to go into commission.

Eureka County.—As reported by F. T. M. Torpey, its president, the Eureka-Uncle Sam Mining Co. has closed the purchase of two mining claims—the Hamburg and Southern Pacific, situated south of New York canyon and adjoining the Uncle Sam south end-line. The Hamburg mine, at one time extensively prospected, has been idle for about 27 years. William P. Dewey, of San Francisco, once a prominent adventurer in the mines of Eureka district, was the leading spirit in the Hamburg company, and at his death was succeeded by his son, Eugene P. Dewey. The addition of the Hamburg to the Uncle Sam property will extend mining and milling operations for many years. A great deal of exploratory work has been done, resulting in the development of a considerable tonnage of ore, some of it assaying high in gold and silver. If the plans for development along the Uncle Sam adit-level materialize, the cost of mining will be 50% lower than it was in the early days of development. The Southern Pacific claim, which parallels the Hamburg, was located to provide a place for a shaft that would reach the ore-bearing limestone on its dip eastward. The shaft was down 250 ft. before it entered the limestone zone and is now 860 ft. deep. The timbers to the 250-ft. level have been crushed, so nothing will be done with the shaft at present. The Hamburg company opened up levels at the respective depths of 250, 450, 600, and 800 ft., with the intention of going down to a depth of at least 1000 ft., but on account of the descending price of silver and lead, the mine became unprofitable to work, and was closed down. Much of the ore left in sight contains either little or no lead and is believed to be amenable to cyanidation; the products of the Uncle Sam and Hamburg mines will be treated eventually in a combination mill, of 200 tons daily capacity. The Uncle Sam adit enters its portal near the head of New York canyon, and has been driven about 900 ft. It therefore must be driven about 500 or 600 ft. farther to the north end-line of the Hamburg and 400 to 500 ft. farther to the Hamburg shaft, which it will tap at a depth of about 400 ft. It is understood that the Uncle Sam company anticipates working through the Hamburg shaft up to the 300-ft. level, and will then proceed with exploitation. The company will not begin building a mill until next May or June. The equipment at present includes a Chicago Pneumatic 4-drill air-compressor, and Clipper drills made by the Denver Rock Drill Company.

Mina.—The new mill of the Simon Silver-Lead Co. is a success, having been operating daily on three 8-hour shifts since December 24, with the following results: The silver-lead concentrate assays average 35 oz. silver and 50% lead, and carries about 8% zinc, making a recovery of over 80% of the lead and silver in the form of lead concentrate. The zinc concentrate averages 42% zinc, 6% lead, and 5 oz. silver, a recovery of 62% of the zinc, thus making a total recovery of about 90% of the silver and lead. It is expected to recover most of the silver and lead in the zinc concentrate at the company's smelter at Harbor City, California. Eight carloads of silver-lead concentrate are at the smelter or en route, and one carload of zinc concentrate is at the zinc smelter. Silver-lead concentrate is now being produced at the rate of three carloads per week, and about the same amount of zinc concentrate.

UTAH

Alta.—What is believed to be the downward extension of the Rustler orebody has been encountered in a drift from the Quincy tunnel level at the South Hecla mine, about 1200 ft. below the surface, according to George H. Watson, president. The old Rustler mine adjoins the South Hecla, and its lowest workings are 600 ft. above the drift where the ore-shoot has been uncovered. The orebody is about 6 ft. wide, and average assays give returns of $1.80 gold, 31 oz. silver, and 16% lead, or approximately $47 per ton, gross. ——An interesting showing is being followed in the Price mine, in a raise upon a fissure that cuts the main tunnel about 750 ft. from the portal. Several streaks of high-grade ore, varying from 1 to 6 in. wide, assay as high as 485 oz. silver and 46% lead. It is believed these ore-stringers lead to a favorable lime-bed, a short distance above.

Eureka.—Official announcement was made on January 14 that the Grand Central Mining Co. had been acquired by the Chief Consolidated Mining Co. Paul Hilsdale obtained an option on the Grand Central property three months ago, and it has been understood that he was representing the Chief Consolidated interests. Cecil Fitch, general manager of the Chief, announces that a vigorous development campaign will be undertaken, particularly on the lower levels of the Grand Central. The Plutus mine, controlled by the Fitch interests, adjoins the Grand Central, and it is proposed to develop the Plutus from Grand Central workings. About 100 lessees are now working in the Grand Central, and this system will be continued. The Chief Consolidated is driving four drifts from the Water Lily shaft, each below the water-level. Each of these headings is going forward at the rate of 400 ft. per month, and this work is in charge of the Walter Fitch Co.——Ore shipments for the week ending January 14 totaled 152 cars, of which the Tintic Standard shipped 59; Chief Consolidated, 37; Victoria, 13; Grand Central, 10; Colorado, 8; Eagle & Blue Bell, 7; Dragon, 8; Swansea, 4; Iron Blossom, 3; Centennial Eureka, 2; Tintic Drain Tunnel, 2; Mammoth, 1; Gemini, 1. Shipments the previous week totaled 140 cars.

Gold Hill.—Operations are to be accelerated at the Carnation mine, 36 miles from here, a small producer of high-grade silver-lead ore, according to T. E. Wessel, manager for the company, who recently returned from Salt Lake City. At present the ore is being hauled to Oasis, on the Salt Lake Route, a distance of 82 miles, the road to Gold Hill being in an impassable condition. A new ore deposit has been discovered to the south of the shaft, averaging 250 oz. silver and from 35 to 40% lead. The ore carries little silica and an excess of iron. The ore being mined at present in the developed portion of the mine carries from 100 to 400 oz. silver. Orebodies found in other properties in that district have been irregular in size, but those in the Carnation mine are exceptionally regular. The ore is found in shoots from 2 to 4 ft. wide.

Park City.—George L. Bemis and George W. Morgan, of Salt Lake City, have been elected directors of the New Quincy Mining Co., thus increasing the directorate to seven members. During the past year, 139 tons of ore, all from development work on the 700-ft. level, was shipped, netting the company $5163.28.——Ore shipments for the week ending January 14 totaled 1983 tons, of which the Judge allied companies shipped 943; Silver King Coalition, 720; and the Ontario, 320. Shipments the previous week totaled 1968 tons.

Salt Lake City.—The U. S. Smelting Co. recently completed shipment of 41 cars of bonded lead bullion from its Midvale smelter to Eastern refineries. The lead was contained in ores received from Canadian mines. Under the tariff regulations, Canadian producers are permitted to ship their ores into this country, under bond, for reduction, and an equivalent amount of the metal can be withdrawn from the smelters for export, without paying duty. The withdrawal may be made any time within three years. The metal shipped from the Midvale smelter has been there for almost a year, the last Canadian ore being received in February. This ore was of great benefit to the smelter, as it averaged high in lead. The Midvale smelter has no refinery, and the silver in the bullion will be extracted at Grasselli, Indiana, and the lead shipped to Europe.——Salt Lake County has renewed its fight in an effort to compel the Utah Copper Co. to pay taxes on its tailing pond at Garfield. Several weeks ago, Federal Judge Tillman D. Johnson handed down an opinion in favor of the company, holding that the county could assess a tax only on the net proceeds of metals that might be derived from treatment of the tailing. The company thereupon endeavored to collect $148,520 paid during 1917 and 1918 as taxes on the tailing. The new suit is based on the theory that the tailing is personal property; the ore from which they were derived having been removed from the mine, part of the mineral extracted, and the remainder impounded for possible future recovery.

Stockton.—E. V. Anderson, a director of the Stockton Standard Mining Co., reports that conditions in the mine are more promising than at any time in the past three or four years. Two veins, showing strong mineralization, have been cut on the 400-ft. level. At present the company is drifting to the south-east in a lime-belt lying between the two veins, to intersect a quartzite-limestone contact along which the mineralization was opened on the 200-ft. level.

WISCONSIN

Highland.—N. J. Garlock, a buyer representing smelter interests, is collecting samples of carbonate zinc ore available for prompt shipment. Quotations will be made as soon as the analyses are available, and sales are possible of about 1000 tons now ready for shipment.

Linden.—J. S. Huxtable has purchased the surface plant of the Optimo Mining Co., one mile north of this village. A new company will be organized; it is intended to repair the mill and to resume underground work at Optimo mine No. 3.

Mineral Point.—The zinc oxide works, owned and operated by the Mineral Point Zinc Co., are in active operation. Of the 48 furnaces 34 are in operation, the remainder being under repair. The warehouses, capable of storing 50,000 barrels of the finished product, are about half full. Considerable quantities of zinc oxide are now being packed in 50-lb. sacks, in addition to the stock packed in 300 barrels for shipment. The acid plant is partly dismantled; it will not resume operations, it is stated.

Platteville.—Mill No. 2, constructed for the Block-House Mining Co., by John Mayhew, contractor, is complete and ready to start when conditions warrant. The Block-House mine when it shut-down had a reserve of 1200 tons of crude concentrate; about 800 tons of finished separator blende is carried in storage.

BRITISH COLUMBIA

Lillooet.—Two syndicates have started work on placer deposits at Lower Bridge river, and several cars of machinery and lumber have been shipped in from here.

New Hazelton.—Arrangements have been made for the reopening of the American Boy mine, at Nine-mile mountain, as soon as weather conditions allow. A consignment of 250 tons of ore from the American Boy was treated at the Silver Standard mill in 1918; since then the mine has been closed.

Prince Rupert.—The Guggenheim interests are stated to have purchased a one-third interest in the properties of the B. C. Silver Mines, Ltd., which adjoin the Premier mine, for $100,000. A controlling interest in the properties is held by the British Canadian Silver Corporation, of London; the company's engineer, C. A. Banks, states that he believes the information to be correct. H. J. Bush and associates, not the English owners, are said to have sold their interest in the property.——P. Sloan, formerly manager of the Drum Lummon mine, recently bought a gold-copper property on Prince Royal Island from the Rivers Bight Syndicate, and is developing ore. At the present time only 12 men are employed, but more will be added as the mine develops.——The net earnings of the Belmont-Surf Inlet mine for the quarter ended September 30 was $11,144.47.——A compressor is to be shipped to the Homestake mine, at Alice Arm, and operations will be resumed as soon as weather conditions allow.

Princeton.—The Hematite Iron Co., of Bellingham, Washington, has re-located the pay-streak on the old Swan placer claim, on Granville creek, and has six men driving a tunnel 45 ft. above the level of the Tulameen river. The gravel is running up to 50c. per pan in gold and some platinum. In 1886 gold and platinum to the value of $193,000 was taken from this district, but little work has been done since 1888.

Sandon.—It is the opinion of the directors of the Silversmith Mines that the company will be on a permanent dividend-paying basis by June 1. Milling operations were started on December 31, and the first carload of concentrate has been produced. It is safe now to predict that the company will be able to ship about 500 tons of ore monthly. The company has a body of high-grade ore opened, which it is estimated should provide mill feed for at least five years, with the opportunity, of course, during the period of greatly increasing the ore-reserves by development. The present ore-shoot, as opened, is 450 ft. long on the No. 10, 8, and 5 levels. It is 2 to 42 ft. wide, the average being 7½ ft. A winze has been sunk 100 ft. below the No. 10, and some good ore has been exposed, but sufficient work has not been done to determine if the shoot persists at the same depth and length as on the levels above. Ore possibilities remain above the No. 5 level and below the 1100-ft. depth. It is believed the average grade of this shoot is 21 oz. silver, 10½% lead, and 10% zinc. From June 1, 1920, to June 1, 1921, the company shipped 2195 tons of ore that netted $260,404 after freight, smelter charges, and lead duty were deducted. Its average content was about 100 oz. silver and 65% lead. There is now on hand about 2000 tons of zinc concentrate having an average content of 43% zinc and 35 oz. silver which will be sold when it can be marketed with advantage.

Sidney Inlet.—Operations will be resumed soon on the Tidewater Copper company's property, Vancouver Island. Important ore-reserves are said to have been blocked out during the period of inactivity at the plant.

Slocan City.—Rich ore is being taken from the Arlington mine, under lease and bond to R. R. Hedley, and from the Anna group, owned by Kurt Zimmerman. At the Ottawa mine, L. H. Biggar and associates have had a tube-mill in operation during the past year; a few shipments of ore have been made to the Trail smelter, but difficulties had to be overcome in the completion of the plant, chiefly in the obtaining of pebbles and lining. A new steel lining has been obtained and a change has been made from pebbles to steel balls.

Stewart.—Regular shipments of high-grade ore are expected from the Silverado group of mineral claims within a few weeks. The ore will be transported across a gulch by aerial tram, then to the lower camp by tram, and from that point will be raw-hided to tidewater.——The Premier mine is the only substantial shipper from the district at present, but many miners and prospectors are wintering at Stewart and Hyder. George Clothier, the resident mining engineer, is advocating more trails and it is assured that Government assistance will be forthcoming. The regions of Salmon River, Fish Creek, Marmot River, and the more distant Unuk River will see much prospecting and more development on promising properties in the prospect stage than ever before.

Describing recent activities of the Premier Mining Co., Salmon river, Portland Canal district, T. J. Shenton, District Mines Inspector, says that the mill has been completed and the 11½-mile aerial tramway began operations on December 20; compressors, coupled to two Diesel units, are in operation; a concrete foundation has been constructed at the foot of Cascade creek for the erection of housing for the machinery of the main power-house, which will be finished early this year. The average number of men employed per day during the year was 328, the total tonnage mined was 15,129 tons, the total length of tunnel and drifting was 4027 ft., the total diamond-drilling done was 6821 ft. About 50 ft. from the entrance of No. 2 tunnel a small shaft has been sunk to a depth of 420 ft. connecting No. 3 and 4 workings.

The Belmont Surf Inlet company's Pugsley mine may be considered an established producer. Ore-bins have been built and an aerial tramway installed from these to the bunkers at the head of Surf mine.

Trail.—Ore received at the Trail smelter totaled 8933 tons from January 1 to 7. Of this, 8809 tons was from the company's mines.

Vancouver.—An appeal has been entered by the Engineer Mining Co. against the recent judgment handed down by the British Columbia courts, which leaves the property in the hands of the heirs of the late Allan I. Smith. It is said that the action will be carried to the Privy Council before the litigants will be content to consider the issue settled. The case involves title to the Engineer mine of the Atlin district.

The Britannia Mining & Smelting Company has let the contract for the fabricated steel work for its new mill-building to the Canadian Northwest Steel Co., of this city, for $175,000; Richard Tench, who superintended the erection of the fabricated steel work at the Trail smelter, will superintend the construction of the building, which will measure 209 by 270 ft. and will be built in six terraces on the hill-side to the west of where the old mill-building stood. Hodgson, King & Marble, of this city, have been awarded the contract to re-build the tramway bridge, destroyed by the flood, for $10,000. The new bridge will be of steel on concrete foundations.

Vernon.—J. F. Getsey, who has been prospecting a property on Monashee mountain, 45 miles east of this town, has packed 750 lb. of ore over the mountains and shipped it to the Kellogg smelter, for a trial test. The vein is 3 ft. wide, and assays give an average of $50 per ton in gold. There is a two-stamp mill on the property which Getsey purposes to put into operation in the spring.

Victoria.—The Hon. W. Sloan has given instructions to the district mining engineers to resume the lectures on mineralogy and field geology started last winter. These lectures will be given in the principal centres of the various districts.

MEXICO

Cumpas.—It is reported that the flotation mill of the San Nicolas lease will be started up shortly. Some development was done last year during the dry season when the mill was shut-down for lack of water. Owing to good winter rains it is expected that the mill will be able to run continuously throughout the year.

Durango.—A number of new mining claims have been recorded in the Inde camp by Miguel Barraza, representing the firm of Barraza Bros., Parral. These claims are all in the Bufa de Inde mountains and are being surveyed into four different groups: The Recompensa, comprising 10 pertenencias, adjoining the Descubrimiento, La Concha, and La Alianza mines; the San Juan group of 9 claims, near La Nina and Corpus Cristi properties; El Tajo, 6 claims near the old mines of Agua Blanca, Nigajar, and Zona Libre, and the Purisima, 10 pertenencias next to the Hector and Anomalia patented claims.——Luciano M. Salas and Carlos Cano, of Durango City, have re-denounced the old San Diego mines, in the municipality of Victoria, this State. The property comprises 10 contiguous claims bearing gold, silver, and lead. It is expected that some shipments will shortly be made.——American mining men have closed a contract with the American Smelting & Refining Co. to ship some large dumps in the Chachihuites district to the smelter at Asarco, near Velardeña.——The dumps of the old San Miguel del Mezquital mines are to be worked over and the best ores shipped to the Asarco plant of the American Smelting & Refining Company.

Nacozari.—The Pilares Extension Mining Co. is pushing development work in three different headings and has some copper-silver ore blocked out. About a carload from the drifts has been set aside for shipping to the Douglas smelter, which is expected to be open for custom ores about February 10. Two more denouncements were recently made on the continuations of the veins. The holdings of this company now cover considerably more than 100 acres of ground between the San Pedro mine and the Zarape concession, both of the Moctezuma Copper Co.——E. H. Devore is now drifting west from the 100-ft. level of the Rubi shaft, and has struck a large quartz-lead carrying native silver and sulphides. He expects to strike the shoot of ore below the 'antigua' workings.

Picacho.—A group of engineers is sampling the Picacho mine of the Moctezuma Copper Co., with a view to taking a lease and bond on the property.

Torreon.—Active mining continues to increase in the Sierra Ramirez of the San Juan de Guadalupe mining district, a short distance south of Torreon. Since the resumption of operations at the Torreon and Velardeña smelting plants, a number of the old mines in this mountain have resumed work and many new claims have been surveyed and recorded.——Eloy C. Rueda has taken up the Ampliacion de la Castellana mine in the Javalias canyon in the Sierra

Ramirez, also other claims known as the 2da Ampliacion de la Burgalesa in the same vicinity. These properties are to be developed together with others by Sr. Rueda.——The San Rafael mines have been re-located by Miss Genieva Benton and will be opened up. These properties formerly belonged to her father, James Benton, and were allowed to lapse during the revolution.——Justino Gonzalez has taken up two new claims in this district, lying east of La Virgin mine.——Luis Audiffred has made some new filings adjoining the Recompensa, Quebradillas, and El Rosario mines.

Zacatecas.—The Espiritu Santo group, comprising four pertenencias or mining claims, in the district of Juchipila, has been located by Jesus Organist. Preliminary development work is exposing some good ores of gold and silver.——David Ruiz Esparaza has denounced a number of new claims next to the old Chino mines in La Bufa mountains near the City of Zacatecas.——Samuel Frias, Hipolito Valdez, Manual Cortes Rocha, Gabriel Castillo, and Isaias Puente, local mining men of Zacatecas, have formed a copartnership to develop the Rio Plata group of mines in the Concepcion del Oro mining district.——Work of repairing the old Reyes smelter, in the northern part of this State, is progressing and it is expected that it will be ready to start up within a few months. American engineers are in charge of this work. The operation of the Reyes smelter will cause renewed activity in the mining industry of that section of the State.

ONTARIO

Cobalt.—The Nipissing during December maintained its high rate of production. The company mined ore of an estimated net value of $251,467, and shipped bullion from Nipissing and custom ores of an estimated net value of $204,869. The winze on vein 251 at No. 63 was down 38 ft. at the end of the month, showing 2 or 3 in. of ore assaying several thousand ounces per ton.——The Right of Way mine, which was recently in liquidation, has been taken over by De La Plante & Co. of Ottawa.

Kirkland Lake.—The Wright-Hargreaves during December increased operations, the mill treating about 5425 tons of ore.——At the Ontario Kirkland the ore is softer than on other mines in the district, so that drilling efficiency ranges from 5 to 25% higher than where the ground is hard, and crushing and grinding at the mill is also easier. The mill has been repaired and is in operation; the first bullion is expected to be produced early in February. At the 450-ft. level, the deepest point of working, there are three ore-shoots, two of them about 200 ft. in length, and two of about the same length at the 300-ft. level.

Lightning River.—Some rich ore has been extracted from a shaft down about 12 ft. on the property of the Lightning River Gold Mines, the vein being about 5 ft. wide. The find has created some excitement in the mining camp, and a number of prospectors are preparing to go into the district in the spring.

Porcupine.—The plans of the Hollinger Consolidated for a large increase of tonnage are considerably more comprehensive than previously stated. The management has in view a maximum of 7000 tons daily as soon as the company is assured that sufficient electric power is available. The company has brought an action against the Northern Canada Power Co., claiming damages of $2,150,000 for failure of the contract to supply the full needs of the mine during the winter of 1920-'21.——Graphitic ore such as caused serious difficulties last year at the McIntyre has also been encountered on the Hollinger, but its occurrence is at a point from which there is no immediate necessity for drawing ore. When it becomes necessary the company can doubtless avail itself of the process adopted by the McIntyre.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

F. F. Mathieu is here from Roux, Belgium.

N. D. Bothwell, of Anchorage, Alaska, is at Seattle.

H. F. Elliott, recently at Tampico, Mexico, is in San Francisco.

Thomas H. Leggett has returned to New York from London.

Arthur C. Kinsley is now at Kingman, Arizona, as mineral examiner.

E. P. Mathewson is returning from Burma by way of Yokohama.

Charles Butters sailed from San Francisco for Nicaragua on January 28.

A. J. Eveland has left Mexico on account of ill health, and is now at Boston.

William Russell, of London, has left Johannesburg, Transvaal, for the Congo.

L. L. Farnham has become chemist and assayer for the R. A. Perez Co., at Los Angeles.

G. B. Rosenblatt has returned to San Francisco from a visit to the mining districts of Idaho.

R. G. Hall, recently resident manager for the Burma Corporation in India, has returned to New York.

George Collins has been re-elected a governor of the Colorado chapter of the American Mining Congress.

Edgar L. Newhouse, chairman of the board of the American Smelting & Refining Co., is at Salt Lake City.

Fernando Montijo, who has been with the Minas Pedrazzini Co., in Sonora, Mexico, is at Berkeley, California.

F. Lynwood Garrison has returned to Philadelphia from Campeche, Mexico, where he has been examined oil-lands.

John K. MacGowan, vice-president of the Braden Copper Co., will sail on February 4 from New York for Valparaiso, Chile.

Douglas Clark has returned from Santo Domingo, Chontales, Nicaragua, and is now at Stanford University, California.

C. W. Beauchamp has resumed the position of mill foreman for the Harmony Mines at Baker, Idaho, which has just re-opened.

George Stahl, vice-president and general manager for the Vindicator Consolidated Gold Mining Co., has been elected president of the Colorado Metal Mining Association.

Edward L. Shera, for five years mechanical engineer to the Cia. Minera Las Dos Estrellas, has resigned to take a similar position with the Mexico Mines of El Oro, at El Oro, Mexico.

C. E. Kindall, of the U. S. Bureau of Mines, has returned to headquarters at Berkeley, California, from Tonopah, where he has been making investigations into miners' phthisis.

D. M. Drumheller, Jr., is returning to the Tidewater Copper Co., at Sidney Inlet, British Columbia, as general superintendent. He has been at Spokane, Washington, while the property has been shut-down.

W. R. Smith, superintendent for the Mineral Point Zinc Co., at Mineral Point, Wisconsin, is recovering from a stroke of paralysis. He hopes to go to California soon. **Arthur Pope**, his assistant, is in temporary charge at the plant.

Thomas P. McNamara, superintendent for the Simon Silver-Lead at Simon, Nevada, is ill in a hospital in San Francisco, where he underwent an operation for intestinal trouble. He was foreman of the Mohawk mine at Goldfield for several years, and was also foreman of the Bluestone mine in Mason Valley.

THE METAL MARKET

METAL PRICES

San Francisco, January 24

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6.25— 8.25
Copper, electrolytic, cents per pound	14.75—15.25
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$105
Platinum, 10% iridium, per ounce	$115
Zinc, slab, cents per pound	6.75— 7.75
Zinc-dust, cents per pound	9.50—10.00

EASTERN METAL MARKET

(By wire from New York)

January 23.—Copper is inactive and easy. Lead is quiet and steady. Zinc is light and demand is lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Jan.	17	65.75	35.00	Dec.	12	65.46	35.44
"	18	65.87½	35.12½	"	19	66.08	35.60
"	19	65.37½	34.87½	"	26	65.50	35.25
"	20	65.00	34.87½	Jan.	2	64.82	34.90
"	21	64.87½	34.75	"	9	64.90	34.83
"	22 Sunday			"	16	66.06	35.31
"	23	64.75	34.75	"	23	65.27	34.90

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	68.24
June	110.50	90.84	58.51	Dec.	131.92	64.78	65.76

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Jan.	17	13.62½	Dec.	12	13.46
"	18	13.62½	"	19	13.58
"	19	13.50	"	26	13.62
"	20	13.50	Jan.	2	13.62
"	21	13.50	"	9	13.56
"	22 Sunday		"	16	13.62
"	23	13.50	"	23	13.54

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	13.54

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Jan.	17	4.70	Dec.	12	4.70
"	18	4.70	"	19	4.70
"	19	4.70	"	26	4.70
"	20	4.70	Jan.	2	4.70
"	21	4.70	"	9	4.70
"	22 Sunday		"	16	4.70
"	23	4.70	"	23	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	4.70

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	32.49

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Jan.	17	5.12½	Dec.	12	5.13
"	18	5.07½	"	19	5.19
"	19	5.05	"	26	5.23
"	20	5.02½	Jan.	2	5.17
"	21	5.00	"	9	5.16
"	22 Sunday		"	16	5.11
"	23	5.00	"	23	5.04

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	5.24

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Dec.	27	48.00	Jan.	10	50.00
Jan.	3	50.00	"	17	50.00
			"	24	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	40.40
June	94.40	85.00	49.50	Dec.	95.00	52.50	49.50

OIL SUPPLY OF THE UNITED STATES

A review of the producing, probable, and possible oil-bearing regions in the United States by a joint committee composed of members of the American Association of Petroleum Geologists and of the U. S. Geological Survey has resulted in an inventory estimate that nine billion barrels of oil recoverable by methods now in use remained in the ground in this country on January 1, 1922.

Unlike our reserves of coal, iron, and copper, which are so large that apprehension of their early exhaustion is not justified, the oil-reserves of the country, as the public has frequently been warned, appear adequate to supply the demand for only a limited number of years. The annual production of the country is now almost half a billion barrels; but the annual consumption, already well beyond the half-billion mark, is still growing. For some years we have had to import oil; and, with the growth of demand, our dependence on foreign oil has become steadily greater, in spite of our own increase in output.

Of the total estimated reserves, five billion barrels may be classified as oil in sight and four billion barrels as prospective and possible. Rather more than four billion barrels should be assigned to the heavy-oil group. These oils will be recovered mainly in the Pacific Coast, Rocky Mountain, and Gulf States. The contents of the Lima-Indiana region, which yields oil of a distinctive type, are estimated at 40 million barrels. In general the so-called paraffin oils of moderate and high grade, as contrasted with the heavier oils, amount in all to about five billion barrels. The estimated reserves of high-grade oils of the Appalachian States are about 725 million barrels.

The estimated reserves are enough to satisfy the present requirements of the United States for only 20 years, if the oil could be taken out of the ground as fast as it is wanted. Should these estimates fall even so much as two billion barrels short of the actual recovery, that error of 22% would be equivalent to but four years supply, a relatively short extension of life. However, the committee expressly decries the too frequent assumption that inasmuch as the estimated reserves appear to be sufficient to meet the needs of the country at the present rate of consumption for 20 years, therefore the reserves will be exhausted at the end of that time or, at most, a few years later. This assumption is misleading, for the oil-pools will not all be found within that length of time, drilling will be spread over many years, as the pools are found, and the wells cannot be pumped dry so quickly. Individual wells will yield oil for more than a quarter of a century, and some of the wells will not have been drilled in 1950. In short, the oil cannot all be discovered, much less taken from the earth, in 20 years. The United States is already absolutely dependent on foreign countries to eke out her own production, and if the foreign oil can be procured, this dependence is sure to grow greater and greater as our own fields wane, except as artificial petroleum may be produced by the distillation of oil-shales and coals, or some substitute for petroleum may be discovered.

In the light of these estimates as to the extent of our supplies of natural petroleum, the joint committee points out the stern obligation of the citizen, the producer, and the Government to give most serious study to the more complete extraction of the oil from the ground, as well as to the avoidance of waste, either through direct losses or through misuse of crude oil or its products.

MONEY AND EXCHANGE

Foreign quotations on January 24 are as follows:

Sterling, dollars:	Cable	4.22¾
	Demand	4.23¼
Franc, cents:	Cable	8.14
	Demand	8.16
Lira, cents:	Demand	4.40
Mark, cent:		0.48½

Eastern Metal Market

New York, January 17.

The dullness usually prevalent at this time of the year is noticeable; the markets are all inactive, but prices are fairly steady.

Copper buying is light, but quotations are firm.

Buying of tin is moderate, active one day and light the next, but values are firm.

Demand for lead continues steady, but moderate at firm prices.

The zinc market is flat, with demand small and quotations easy.

Antimony is lower.

IRON AND STEEL

The common expectation of activity in the early spring is more of an influence in the steel market than anything that buyers have done since the year opened. Operation of steel works has fallen off slightly. It is recognized that replenishment demand still must be counted on for alternating improvement in mill schedules; manufacturing consumers of steel as a rule have no definite plans for increased production in the immediate future. Steel companies are more sanguine of a higher rate of output during the next few months than of a turn for the better in prices.

COPPER

The market is not stagnant but it lacks animation. Consumers covered their near-by needs in November and December, and are not actively interested now. Then, too, inventories and other matters have interfered with any need to purchase. Producers, however, are not pressing their product and are maintaining a firm attitude as to quotations, some not even quoting at all because they are in a comfortable position. Electrolytic copper in the major market is quoted at a minimum of 13.87½ to 14c., delivered, or 13.62½ to 13.75c., refinery or New York. Rumors that this minimum can be shaded to 13.75c., delivered, is confined to small lots in dealers' hands, and the quality is not a market factor, generally considered. Inquiry is fairly good, indicating a good business in coming months; foreign demand continues equal to average recent proportions. Lake copper is quoted at 13.87½c., delivered, with the market quiet but firm.

TIN

There has been activity on some days of the past week and marked inactivity on others. Dealers turned buyers on January 11 and 12 to the sum total of from 400 to 600 tons as a turn-over. This spurt was induced by fears of a shortage of January-February metal, because of a report that the steamer 'Sagadahoc' from the Straits with 1000 tons on board has met with an accident necessitating its making the port of Alexandria for repairs. Markets were quiet January 13 and 14, but on Monday, January 16, pressure to sell developed, and a sloppy market resulted. There were sales on Monday of spot metal and tin on steamers afloat at 32.37½c., with later deliveries sold at 32.25 and 32.12½c., the total transactions amounting to 200 to 250 tons. Yesterday the market was active, with dealers the principal buyers at 32c., the quotation of spot Straits for the day and the market reported firm. On the New York Metal Exchange on January 12 there were sales of 25 tons of January Straits at 33c. and 25 tons of standard tin for spot delivery at 32.50c. The London market yesterday was weak at £163 7s. 6d. for spot standard, £165 for future standard, and £165 0s. 6d. for spot Straits, all about £2 per ton below prices a week ago. Arrivals thus far this month have been 3015 tons, with 4510 tons afloat.

LEAD

The market is quiet but exceedingly firm, with quotations unchanged. Demand is good, but it is not sufficiently strong to change prices, which are 4.70c., both New York and St. Louis, for the leading producer and 4.40c., St. Louis, and 4.70 to 4.75c., New York, for the independents. The market still maintains a waiting attitude, contingent on developments in the steel market, particularly buying of galvanized sheets.

ZINC

Demand still continues light, being confined to hand-to-mouth orders of consumers. Prime Western for early or 30-day delivery is quoted at 4.75 to 4.85c., St. Louis, or 5.10 to 5.15c., New York. For future positions in the first quarter quotations are about five points per month above the quotations for early delivery. According to the December statistics, the production increased about 900 tons, or less than anticipated, whereas shipments exceeded production by about 440 tons, thus reducing stocks to about 66,600 tons at the smelters on December 31. Stocks at the end of the year were about 4450 tons less than at the beginning.

ANTIMONY

The market is quiet and easier, with wholesale lots for early delivery down to 4.45c., New York, duty paid. Jobbing lots range from 4.65 to 4.85c. per pound.

ALUMINUM

Outside of an inquiry for 200 tons, this market is quiet. The leading interest quotes wholesale lots for early delivery of virgin metal, 98 to 99% pure, at 19 to 19.10c. f.o.b. plant; but the same grade from importers is available at 17 to 18c., New York, duty paid.

ORES

Tungsten: Little activity pervades this market; quotations are nominally unchanged at $2 per unit and higher, depending on the grade and other conditions. Chinese ore is the cheapest.

Molybdenum: The market is without feature; quotations are nominally unchanged at 45 to 50c. per pound of MoS_2 in regular concentrate.

Manganese: Stagnation rules so far as new demand is concerned; quotations are nominal at 20 to 25c. per unit, c.i.f. Atlantic ports, for high-grade foreign ore.

Chrome: Stocks are evidently adequate; the market is devoid of activity, with quotations nominal at $20 to $28 per ton, f.o.b. Atlantic ports.

FERRO-ALLOYS

Ferro-manganese: Sales are confined to carload lots for early delivery, consumers buying only for immediate needs. Transactions for the week total about 115 tons, all British, at $58.35, seaboard. The German alloy is quoted at $54, seaboard, and sales by the Carnegie Steel Co. are made at $60, Pittsburgh.

Spiegeleisen: Demand has again fallen off, but quotations are unchanged at $26, furnace, for the 20% alloy. Production is at a standstill, and has been for several months.

Ferro-tungsten: The domestic standard alloy is quoted at 40 to 45c. per pound of contained tungsten, and the foreign at 50c., duty paid, f.o.b. Atlantic ports.

Ferro-silicon: Sales continue of carload and small lots at $55 to $60 per ton, delivered, consumers purchasing only for immediate needs. Contracts for 1922 delivery are in the making, and developments are said to be under way.

Ferro-chromium: Dullness continues, with quotations nominal at 11 to 14c. per pound of contained chromium, 4 to 8% carbon, f.o.b. plant.

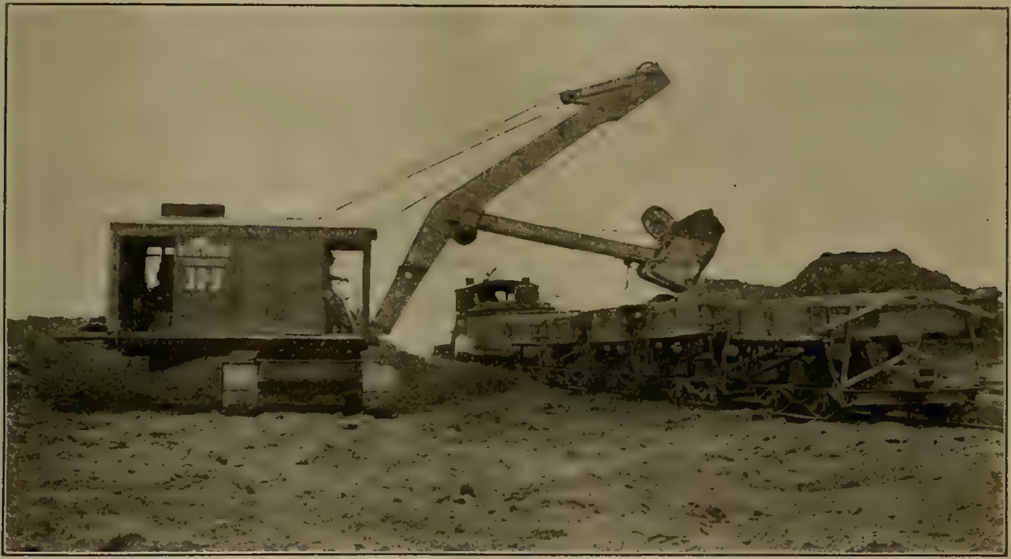
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

AN INGENIOUS REVOLVING SHOVEL OPERATED BY GASOLINE ENGINE

A gasoline-operated shovel with no engines, motors, shafts, chains, or gears on the boom, and yet with an actual digging power greater than a steam-shovel of the same size is the most recent innovation in the manufacture of excavating machinery. The making of such a shovel has recently been announced by the Bucyrus Co. of South Milwaukee, Wisconsin.

This machine, which is known as the 30-B 'gasoline-shovel', marks a distinct advance in the design of excavating machinery. For more than 10 years Bucyrus drag-line excavators have been operated by gasoline-engines, but the application of this power to the revolving shovel involved more difficult and intricate problems, chief among these being the efficient transmission of power to the thrust without excessive complications in design, and the obtaining of digging power commensurate with that of a steam-machine of similar size.



Bucyrus 'Gasoline' Shovel

Both of these problems have been satisfactorily solved in this new shovel. Furthermore, the manufacturers have succeeded in obtaining in this new machine the digging characteristics of the steam-shovel with its quick reversals, its powerful thrust of the dipper, and its dependability. Before being put on the market, this shovel was used for a period of six months for overcasting and loading dump-cars in sticky clay, for grading for a concrete road where the cut averaged five inches in old macadam, and for stripping a stone quarry and loading trucks in a stiff hardpan containing many boulders.

Its unqualified success, therefore, has been completely demonstrated by actual test in the field. The outstanding features of this shovel may be summarized as follows:

It is far simpler than a steam-, electric-, or other types of gasoline-shovels and has fewer parts to maintain and keep in order.

Its digging power is even greater than that of a steam-shovel of the same size.

It has all the well known performance-characteristics of a steam-shovel, even to the shaking of the dipper to relieve it of sticky material.

It will give 20% greater yardage per gallon of gasoline than any other type of shovel of the same size whose power is derived from a gasoline-engine. This is due to less mechanical losses and less waste energy.

The gasoline-engine with which this shovel is equipped is over twice as heavy and rugged as the usual type of commercial gasoline-engine sold for this purpose. It was designed especially for this shovel from specifications offered by the Bucyrus engineers and consequently it is suited for the exacting requirements of this unusually severe service.

It is entirely enclosed and thus dust proof, a feature of much importance for excavating work.

The engine is a four-cylinder slow-speed type, and will develop 55 hp. at a speed of 400 r.p.m.

The shovel carries a one-yard dipper.

This machine may be equipped as a drag-line excavator, a crane, or a clam-shell machine with simple changes which may be made in the field.

The 30-B gasoline-shovel fills a long-felt want, for those whose work is in arid regions or where coal is scarce and expensive, and feed-water of poor character.

A bulletin has recently been issued describing and illustrating this machine in detail, which may be obtained by writing to the Bucyrus Company.

A NEW METALLURGICAL PUBLICATION

The General Engineering Co., consulting engineers with offices in Salt Lake City and in New York, has recently issued an 80-page illustrated booklet styled 'Metallurgical Bulletin'. According to the introduction "The business of the company is the work of putting mines upon an economical producing basis—the examination of mines to determine those factors affecting production; sampling the mine for ore-treatment; analysis and testing of ores; planning for economical recovery of the valuable minerals; design of metallurgical plants based upon the results of metallurgical tests; purchase of equipment; erection and operation of plants; sampling and sale of metallurgical products; and solution of such engineering, metallurgical, and economic problems as naturally arise in these connections. In addition, the plant and staff have served and will continue to be available for the solution of similar problems in industrial work".

The first part of the book deals with the facilities of the General Engineering Co. for doing the work summarized above. The second part is devoted to tables of statistics and sundry valuable data. A section devoted to costs of milling is particularly informing. The following subjects are included: Cost of erection of plants; Electric data; Steam plants; Motors; Pulp-densities; Crushing machinery; Grinding machinery; Screens; Concentrating tables; Conveyors; Elevators; Properties of minerals; Flotation equipment; and sundry miscellaneous information. The book is unusual and should be of exceptional value to metallurgists and mill-men.

ALDRICH PUMP CO. IS DISTRIBUTING A NOVEL CALENDAR

The Aldrich Pump Co., of Allentown, Pennsylvania, has issued its new 1922 calendar; it is now ready for distribution to those who will write for it. The design is a carefully planned arrangement of colors whereby the highest possible luminosity is secured and it is primarily a practical calendar and only incidentally an advertisement. This new Aldrich calendar consists of 13 sheets, size 18 by 25 in. The front sheet is a reproduction of a painting in which the artist presents a modern version of the shop-interior, and the assembling of an Aldrich quintuplex pump. By this version the inorganic materials, such as masses of iron and steel making up the building and machine parts, are given life.

Liberties are taken, in that objects are so arranged as to create patterns and designs. The blue haze of the shops is used as a background against which the pump masses, in black, are placed to make the picture, which is completed by the suggestions of windows and the entering light and resulting shadows. The 12 monthly sheets are, from the colorists' standpoint, 12 scientific arrangements of the six different colors in the spectrum—red, orange, yellow, green, blue, and purple, the colors which form the logical basis for intelligent color calculations.

Since color sensation is the result of definite light vibrations, each color is therefore said to correspond with a definite musical note of corresponding vibrations. This system of color arrangement is said to be in harmony corresponding to musical harmony. The calendar proper, or names of the year, months, days, and the dates, are always in black, giving a high visibility. On each sheet there is also a modern black and white cut of some Aldrich product. This style of cut is a revival of the earliest form of illustration—the most notable examples of which are those of Albert Durer.

WILLIAMSPORT WIRE-ROPE AND MODERN METHODS OF MANUFACTURE

In the manufacture of Williamsport wire-rope unusual precautions are taken to ensure uniformity and quality of every wire entering into its manufacture. The original steel rods are made from special furnaces of the Jones & Laughlin Steel Co. Every 'heat' from the furnace is treated separately and the rods from each 'heat' are shipped together in bundles and kept together throughout the manufacture down to the finished product. As a result every Williamsport wire-rope is absolutely uniform as to composition.

To maintain uniform strength every rod and wire as drawn is tested and re-tested during the course of manufacture and all rods and wire that do not come up to Williamsport standards are rejected. The result is a rope that is uniform as to quality, strength, and size and that is made up to the standards set and guaranteed by the company. To assure the consumer as to exactly what he is getting in Williamsport wire-rope, the company has patented a 'Telfax' tape which is woven into the hemp centre of the wire-rope. Both the color of the tape and the statement on the tape, neither of which can be tampered with, tell the consumer just what type and grade of wire-rope he is purchasing.

The Williamsport Wire Rope Co. has recently prepared a booklet entitled 'Modern Wire Rope', which is of interest to wire users of rope and can be obtained upon request by addressing the general sales offices of the Williamsport Wire Rope Co., Peoples Gas Bdg., Chicago, Illinois.

COMMERCIAL PARAGRAPHS

Electric-arc welding for repair and reclamation, general applications of arc-welding, and arc-welding for manufacturing processes are well described and illustrated in Leaflet 1825, just published by the **Westinghouse Electric & Manufacturing Co.**, East Pittsburgh, Pennsylvania. A story is told of how costs are reduced by the use of arc-welding.

Frank Kiernan & Co., advertising agency, 135 Broadway, New York, has opened a business-paper department under the personal direction of Alfred N. Williams. Mr. Williams, formerly of the Fairchild publications, and with an experience of 17 years in trade-paper and advertising-agency work, declares that this department will accept as clients only those who will use, as their basic advertising, the business papers in their respective fields.

The Carroll Chain Co., of Columbus, Ohio, announces that it is going to make steam-shovel loading chains especially designed to meet the exacting requirements of open-cut mining. The 'Carroll' weld will eliminate the expensive breakdowns that cause the annoying shut-downs. Although the company is newly organized it has a personnel that is thoroughly experienced in all phases of chain manufacturing. Daniel Carroll, president and general manager, has had 50 years experience in the business.

The Pelton Water Wheel Co., of San Francisco and New York, has issued Bulletin No. 17, 'Pelton Water-Wheels (Impulse Turbines) and Reaction Turbines'. The bulletin describes the various types of hydraulic equipment manufactured by the company, and discusses their application both to the generation of hydro-electric power and to the direct operation of many different kinds of machinery. Some space is also devoted to governors and to pressure-regulating devices. The bulletin comprises 48 pages and is illustrated by a number of drawings and photographs. Copies may be obtained upon application to either office of the company.

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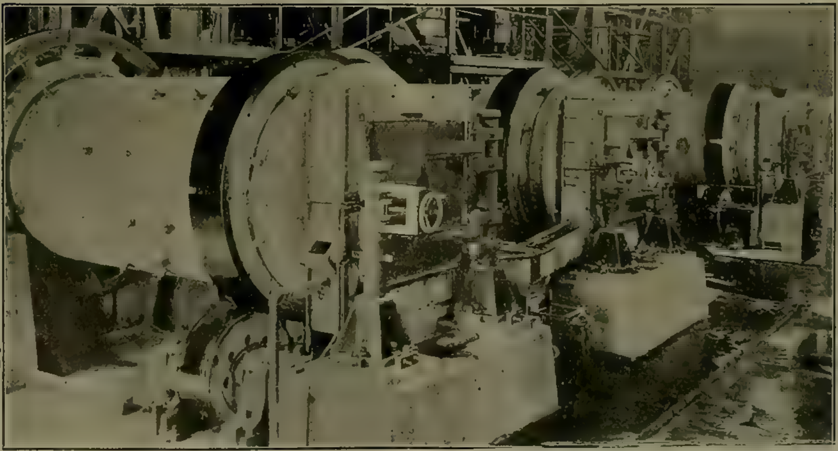


The Phelps-Dodge Corporation is Installing Forty-Two Large Marcy Roller Mills

T. A. RICKARD, ... Editor

JUDGE George B. Winston of Montana decided recently that when N. B. Ringeling, of Philipsburg, paid $2000 to E. A. Hannah for sundry unpatented mining claims they reverted to the Government because Mr. Ringeling was a U. S. Deputy Mineral Surveyor at the time of the purchase. The decision is interesting and will be noted by other surveyors of the same status.

AMONG our recent subscribers is the Superintendent of the Mineral Survey of the State of Kashmir, that beautiful valley in the heart of the mountain-land lying between India and Afghanistan. The money-order sent by him was based on the rate of exchange ruling at the date of remittance, and when it arrived the exchange had dropped so much that there was a deficit of $1.65 on the $6 subscription. This was corrected as soon as letters had passed to and fro, across a distance equal to more than half the earth's circumference.

THE last batch of pamphlets from the Institute is devoted to the following subjects: 'Time to Pay Out as a Basis for Valuation of Oil Properties', 'Effect of Time in Reheating Quenched Medium-Carbon Steel Below the Critical Range', 'New Features in Structural Geology of the Anthracite Basins', 'Malleableizing of White Cast Iron', 'Storage-Battery Locomotive as Applied to Mine Haulage', 'Acid Open-Hearth Process for Manufacture of Gun Steels and Fine Steels', and 'Subsurface Conditions on Portion of Arches Fork Anticline'. Shade of Dr. Raymond! What titles—have a heart for the indexer, Mr. Secretary—and what a thrilling lot of stuff for Western engineers! Only one of these papers would appeal to members of the Institute in Denver, Spokane, Salt Lake City, or San Francisco.

IN the 'Boston News Bureau' we note a paragraph telling how the Utah Copper mine was discovered and correcting a yarn to the effect that Mr. Spencer Penrose was the discoverer. The 'Bureau' uses the information given in our articles on 'The Utah Copper Enterprise' and therefore, of course, is correct in its statements on this matter. Mr. Spencer Penrose was only one of the promoters; his brother, Mr. Richard A. F. Penrose, however, was more than that, because he is a mining geologist of the first rank, so that his favorable professional opinion of the property aided the purchase from Colonel Wall. The man that 'discovered' the Utah Copper was the man that had the constructive imagination to see how it could be made a profitable enterprise, and that man was Mr. Daniel C. Jackling.

OPPOSITION to the publication of almanacs by the Government, including the Miners almanac for 1922 recently issued by the U. S. Bureau of Mines and the Public Health Service, was made by Representative Johnson of the Congressional Printing Commission, which is endeavoring to curtail Government publications. Mr. Johnson said that whereas the Bureau of Mines almanac was worth something, he did not think the Government should go into the almanac business, "especially when some of the almanacs gave the birthdays of Cabinet officials". He said that the Miners almanac was published before the Committee on Printing knew about it. This suggests forcibly how the taxpayers' money is wasted at Washington. We need a few more conservative Congressmen like Mr. Johnson.

SOME of our Canadian friends claim that the Hollinger mine is the biggest gold-producer in the world, that is, that its output of gold is the largest. The most recent figure for the Hollinger's output in 1921 is $9,000,000. According to the latest annual report of the New Modderfontein, in South Africa, that mine produced 527,477 ounces of gold, which, at $20.67 and disregarding the so-called premium, makes a total of $10,900,000. Comparison has been made with the Crown Mines, also in South Africa, but that enterprise is a consolidation of several companies. It is fairer to restrict comparisons to individual mines. Apparently our Canadian friends are not far wrong, for the Hollinger's operations are expanding and it is probable that during the current year it will win the first place. We hope it may.

IN our issue of July 23 we outlined conditions in the U. S. Patent Office at Washington, giving space to an article that emphasized the need for immediate action. On January 12 what is known as the Lampert Patent Bill passed the House of Representatives by a vote of 198 to 36; the measure is now before the Senate Committee on Patents. Opposition in the House was confined to a small minority, who object, apparently, to any expenditure on any account. Their attitude in this case, however, proved to be more than inconsistent, for if the Lampert Bill be passed, the additional cost of operating the Patent Office, on account of enlarged staff and higher emoluments, is to be met by an increase in the fees to be paid by those applying for patents. Almost all the work in this connection is done when the application is made, the initial fee for which is $15. Under the provisions of the proposed law the first fee will be $20, and it is expected that this will result in an additional income amounting to about $500,000 per annum. The sponsor of the measure recently pointed out that the increase in work in the Office during recent years has overwhelmed the staff. At the present time there are over 59,000 patent applications and about 6000 trade-mark applications awaiting examination and decision; as the result of wholesale resignations more than half the force consists of untrained men. We trust that the bill receives the speedy support of the Senate. The reorganization of the Patent Office is long overdue.

CALIFORNIANS residing in the tropical climate of Boston and New York will be interested to hear about our snowstorm on Sunday last. In Berkeley the snow lay three inches thick on vacant lots, and on the near-by hills it was as much as five inches thick. To many of the children and to a few adults the snow was something entirely new; they indulged joyfully in snowballing and in making snow-men; they loaded the hoods and running-boards of their automobiles with snow, and even piled it on top of the cars. To the mining engineer who has fought his way by aid of snow-shoes over the white wastes of winter, this exuberance was amusing. "Snow, beautiful snow" may be poetic to some; it leaves us cold. The heaviest snowfall of which we have experience was in eastern Oregon, in the Eagle mountains, near Cornucopia. There we remember an aggregate of 46 feet during one season and a maximum thickness of 18 feet on the flat at one time.

A POSTCARD from Vancouver, signed by our good friends Messrs. Nicholas Thompson and H. Mortimer-Lamb, has reached us. These worthy gentlemen, in their respective capacities as chairman and secretary of the British Columbia division of the Canadian Institute, solicit our vote in behalf of Mr. W. R. Wilson, of Fernie, for the presidency of the Institute. We know Mr. Wilson, so that the idea wins an instantly hospitable reception in our subconscious mind. The postcard says that the presidency has not been held by a British Columbian member since 1907 "notwithstanding the fact that nearly a quarter of the total membership of the Institute is in British Columbia". On the basis of true representation the presidency ought to fall to a Pacific-Coaster once in every four years. The protestants say further that "the Institute is essentially a national body and to ignore the rights of representation of any one section for no better reason than its distance from headquarters is incompatible with the national principle". So it is. Go to it, gentlemen! The distance from headquarters does not measure the distance from the places of actual mining; on the contrary, British Columbian members, as we happen to know, represent the type of men that are the very backbone of the Institute. The idea that the West, especially the Pacific Coast, is on the fringe of creation is a belated fallacy. Here ends the path of empire; we fellows who like Balboa look across the Pacific seas constitute no 'branches' of a trunk on the Atlantic seaboard; we are co-partners in the firm and brook no patronage, but insist on our rights! Let Montreal and New York sit up and take notice!

HAND-LABOR has been considered essential in many important operations, but the introduction of machines for special work is proof that human energy is often wasted on tedious and mechanical tasks. The polishing of diamonds is said to have commenced during the 14th century in Holland; from there the industry migrated to England, then back to Holland. After the Great War, work of this kind was again started in England, to provide occupation for ex-service men. The procedure adopted to cut and polish a diamond underwent little change throughout many centuries; the diamond is cut with wire, to which diamond dust has been made to adhere. The workers are classed in three groups: the 'turners', who set the stone in the lead; the 'cutters'; and the 'brillianders', who cut the 8-star and 16-star facets above the 'girdle' and the 16-star facets below it. Great skill is required. A cutter can operate four 'tongs' at one time, but the 'brilliander' must confine his attention to only one stone, for fear of wastage. The workers acquire a marvelous knack; and their aptitude for the task is handed down from generation to generation. It is probable, however, that such workers may now be able to divert their energies to something less mechanical, for Mr. S. Schenken, of New York, has devised a machine that is likely to revolutionize the diamond-cutting industry. If the claims of the inventor are realized there will be no need for the 'turners'. The diamond is set and fastened in the usual way, after which the polishing operations are entirely automatic. Not only will an economy of human effort result, but there is no danger of over-cutting and waste, for the grinding is stopped by automatic control as soon as the correct depth of cut has been made. One operator can attend to about ten stones, thus indicating a saving of labor that must inevitably presage the disappearance of an occupation that has provided employment for a large number of men.

THE first contribution to 'Discussion' this week is a letter from Mr. Morton Webber in which he replies to sundry comments and criticisms upon his article on the valuation of partly exhausted mines. This reply of his is courteous and useful. In regard to the effects of erosion in enriching or impoverishing ore deposits as man now finds them, it is well to remind both Professor Roberts and Mr. Webber that Mr. H. V. Winchell discussed this phase of the subject 15 years ago, and they will find many suggestive remarks in Mr. Winchell's article—a commencement address delivered at the Montana School of Mines—as printed in our issue of July 13, 1907. From that address we quote two remarks: "Where erosion is more rapid than oxidation the unoxidized sulphides will be found in the rocks and veins at the surface of the ground and in the sand rolling down the beds of torrential streams as in Alaska, while if oxidation precedes erosion, the uppermost zone of a sulphide ore deposit will be oxidized and leached of its base minerals, as is the case here in Butte". Further on, he says: "Oxidation, which is but another name for combustion, is greatly accelerated or retarded by slight changes in temperature. Sulphides that remain immersed for centuries in water under a glacier in Alaska would be completely oxidized in a few years [if] exposed to the heat of the sun on a southern slope in Colorado or California". To this we venture to add the suggestion of a comparison between the Kennecott copper deposits and those of Bisbee, as they appeared at the surface and in the upper workings of the mines. In publishing Mr. L. O. Howard's letter in our issue of October 22, we omitted the sketch that he sent to explain his discussion of Case B, originally used by Mr. Webber to illustrate his own argument. We have inserted Professor Howard's sketch on page 153 of this issue. The question of the dividend that a base-metal mine should pay, that is, its earning capacity with reference to the capital it has consumed, is an important one. We regret that Mr. Webber's remarks on this point have elicited so little comment. He calls for a return ranging from 15 to 30%, and dependent upon the ratio of production to capitalization. His suggestion of using the average metal price as a datum line and asking for a 7% return on the sales at that price is novel and well worthy of further consideration. All these are matters of the utmost practical importance, for they lie at the foundation of the mining business.

IF the railroad companies will establish freight-rates on ore approximately equal to those existing before the War the tonnage of ore hauled monthly by the Western railways will increase within 90 days fully 60% over the average of the twelve months of 1921, according to Mr. W. H. Prickett, who as representative of the Governors of seven Western mining States addressed the Interstate Commerce Commission at Washington during the hearing on the readjustment of rates on ores and metals. Using the mining industry of Utah as an example, Mr. Prickett showed that 6040 cars of ore were shipped to the smelters in 1919 under the scale of rates now in effect, and that the resulting revenue to the railroads was $123.39 per car for an average haul of 76 miles, which was equivalent to 34 mills per ton-mile. He argued that this could be diminished 25% and still leave a reasonable profit; and that, at the same time, many of the idle mines could be worked profitably as a result of the revision. A reduction to pre-war rates would mean an average saving of 47 cents per ton on the haulage from the mine to the smelter; a reduction of $1.50 per ton on the rate for lead bullion shipped to New York would amount to 25 cents per ton of 5% ore; and the reduction in wages has cut 25 cents per ton from the cost of production. Lead ore from Utah mines averages about 100 pounds per ton, according to the figures given, so that the readjustment of rates would make the saving in the cost of delivering lead to the refinery about one cent per pound. This would be sufficient to cause decided increase in the production from the mines. The problem of fixing freight-rates is complicated by a score of factors that the layman does not understand, one of which is the complex differentials that cannot be ignored. It was an easy matter for the Commission to order arbitrary increases, but it is not so easy to unravel the tangle that resulted. One thing is certain, the railroads need traffic and they will necessarily take steps to stimulate it. A district in which the mines are idle means a greater loss to the railroad than the loss of the revenue from hauling ore; it means loss of a dozen other kinds of traffic. If the ore can be moved without an actual operating loss it will, speaking generally, pay the railroads to haul it, even if to do so they have to fix a rate abnormally low. There is, however, the deterrent of the certain difficulty of re-establishing a higher though still justifiable rate when the mining companies become more prosperous. We are convinced that freight-rates on mine-products are disproportionately high and that they must come down. The sooner they are decreased the better for mine-owners and railroads alike.

Cold-Water Thawing in the North

Ice is the chief obstacle to the successful exploitation of the gold-bearing gravel of Alaska and the Yukon. At first, during the rush of 1898 and for some time afterward, the miners in the North used wood-fires to thaw the ground for the purpose of facilitating the sinking of shafts to bedrock. Clarence J. Berry noticed that the escape of steam from the exhaust of his engine had thawed a hole in the frozen mud. The accidental observation of this result sufficed to give him the idea of applying steam through a pipe. Thus the 'steam-point' was invented. It was supposed to be the last word in Arctic mining methods, although it was expensive; but five years ago, during the season of 1917, John H. Miles, while making experiments on the Third Beach, near Nome, found that cold water was more effective than steam. He tried super-heated steam, saturated steam, warm water, and lastly cold water, as described in our issue of March 3, 1920, in an article prepared by Mr. Walter S. Weeks, who took the trouble to analyze the results, which showed that of the total heat applied the following proportions were effective in doing the useful work of thawing: super-heated steam 4%, saturated steam 6%, hot water 12%, and cold water 57%. The temperature of the cold water was 52°F. The data given in this article show that the relative thawing efficiency was 0.69 cubic yard per hour for the super-heated steam, and then 0.84, 1.2, and 2.6, respectively, the last being the number of cubic yards thawed per hour by the pipe that admitted the cold water. This discovery was heralded as most important because it promised to reduce considerably the cost of thawing and therefore the cost of mining in the Arctic region, that is, wherever Glacial conditions linger. Now comes a further advance in the technique of the subject. In this issue we publish an article by Mr. Edward E. Pearce describing the thawing of frozen gravel by means of the downward seepage of surface-water through the thawed ground around a shaft to bedrock and the subsequent pumping of that water, so as to promote the circulation. Mr. Pearce made his experiments during 1918 and 1919 at Candle, 200 miles north of Nome, on the Arctic slope of Seward peninsula. He had been manager and assayer for the Miners and Merchants Bank at that remote mining centre before he joined Mr. Iver Johnson, of Fairbanks, in starting a dredging enterprise on Candle creek in 1912. This is the 'farthest north' for dredging. After his first experiments with the use of a flow of cold water through a pipe, the first question was the amount of pressure needed to force the water into the gravel by means of the pump. He found that a pressure of 25 pounds at the 'points' was satisfactory. Above this amount he found that he had to raise double the amount of water twice the height in order to make a gain of only 12% in the yardage thawed. He started by spacing his points five feet between centres, but later he found it better to use intervals of 10 feet and allow more time for the thawing. The points were left in place for 72 hours after reaching the bedrock. The average temperature of the entering water was 55°F, and the average temperature of the water returning from the points was 35°. He left frozen collars between all points, having ascertained that such remnants would become thawed in due course by a benevolent assimilation. During this series of experiments with the ordinary 'points' he developed the method described in the article, to which we take pleasure in referring the reader.

International Disposition of Minerals

On many occasions during recent years it has been evident that laws and agreements would be needed to prevent friction and conflict over the exploitation and disposition of the mineral resources of the world. A committee to study the subject was appointed last year by the Mining and Metallurgical Society of America, consisting of Messrs. C. K. Leith, H. Foster Bain, S. H. Ball, Van. H. Manning, George Otis Smith, A. C. Veatch, H. V. Winchell, and Pope Yeatman. These gentlemen have now submitted a report in the form of a recital of what they term elemental considerations. The question is within the domain of international politics; the inquiry was made in the interests of the conservation and the efficient use of the world's minerals, wherever found, and to prevent or minimize international difficulties arising from their discovery, development, transport, and marketing.

Mineral resources are wasting assets that are fixed geographically by nature; change in this distribution is not within our power. Some minerals are so widely distributed that nearly all countries have adequate supplies within their own boundaries or near at hand; others occur in such manner that in some parts of the world there is a large surplus, elsewhere a deficiency. No country is self-sufficing in regard to supplies or markets for all mineral commodities; certain minerals are available in excess for export, whereas others are deficient in quantity, and must be imported either in crude or manufactured form. The international exchange of minerals cannot be avoided if all countries are to be supplied with what they need; such movement may be aided or hindered by bonuses, preferential duties, tariffs, or embargoes. These measures may be desirable locally or temporarily; but it is the Committee's belief that measures of this kind, aimed as they are at the ultimate closure or diversion of the main international channels determined by nature, are doomed to failure; the effort to apply them will involve needless readjustments; friction, international and domestic, will result. When, for instance, it is proposed by tariff to foster an infant mineral industry, the geologic facts should be faced, to make sure that such a course is practicable; otherwise much energy and capital may be wasted in attempting to develop deposits in districts where the minerals are not present in sufficient abundance to justify exploitation. Resources of this kind cannot be created by legislation. It would be futile to attempt to make each State in the Union self-supporting in regard to all minerals; it is equally impossible to make a country independent of all others. Specialization of effort on particular minerals in particular localities seems essential to the conservation of human energy and to the most efficient utilization of natural resources. For example, if the distribution of raw material is such that the United States can specialize in the production and export of copper and iron and steel, and can do this efficiently, it seems undesirable that any considerable amount of effort should be devoted to the development of the inadequate deposits of tin and nickel; for other countries can produce these metals more efficiently. Some minerals are so distributed that the need for import or export is not apparent; in such cases there may be reasons, other than of necessity, for aiding or restricting such a movement.

In the interest of reduction of bulk as well as of efficiency of transportation it is the opinion of the Committee that the concentration and refining and fabrication of minerals near the sources of their supply should be encouraged, if possible. Countries fortunate enough to possess large supplies of a mineral that is sparsely distributed elsewhere are entitled to the advantages that may accrue from the conversion of raw materials and from fabrication, unless local conditions make this possible only at excessive cost. Coal is the principal energy-resource available for this work; and experience has shown that many minerals can be utilized with greater efficiency near coal mines than at their own sources. With this consideration in mind the Committee does not favor the application of government measures to aid or restrict an attempt to establish a local smelting or fabricating industry in a district where the supplies of raw materials (including coal) are such that the cost is excessive and the efficiency is low as compared with those in more favored localities. Shipping conditions are sometimes such that it is a cheap and efficient plan to transport crude ores in order to secure proper combination cargoes and to balance local imports and exports. It is maintained that the continuous exploration and development of mineral resources are necessary to replenish ore-reserves that have been depleted by production. The present century has witnessed the maximum consumption to date of minerals; in the United States the per capita consumption has multiplied ten times in forty years. The problem of replenishment is not an incidental one, but is of basic importance to the prosperity of the expansive mineral industry that can be foreseen as a result of further growth. Any restrictions, national or international, that interfere with the necessary searching of the earth are undesirable in principle. The necessity and the economic justification, during exploration, particularly in the case of oil, of the securing of rights covering large areas, in order to induce and to warrant the expenditures necessary for careful exploratory work in new regions, is recognized. In those instances in which such concessions are safeguarded by the stipulation that within a limited period of, say, three to five years the holder must select for retention a small part of the original exploration area, the result is development without exclusion. Exclusive concessions on large areas without such a reduction factor are unsound economically. It is believed that the aid and supervision of governments may be desirable in connection with exploratory work, if such intervention does not destroy the opportunity for private effort; but government agencies cannot replace private initiative other than at the expense of that elasticity and variety of attack that is essential to the adequate solution of the complex problems of mineral discovery and development. Equal opportunity and the open door—national and international—is insisted upon; these are considered as implying, among other things, that, except under a condition of national crisis, there shall be no restriction on the issuance of mining licenses and concessions to foreigners or on the transfer of concessions to them; and that there shall be no restriction as a result of the nationality of the shareholders or managers or directors in companies owning mining and exploratory rights and concessions, allowing thereby the free purchase and acquisition by individuals of any nationality. The right of nations to control their own resources in times of war is recognized, of course, as paramount; and there may be local or special circumstances that might make such control desirable in times of peace. For the most part, however, all large mineral operations are carried on by incorporated companies; the company being under the protection of the State, the latter may and usually does define its rights and powers, and in this manner protects its own interests.

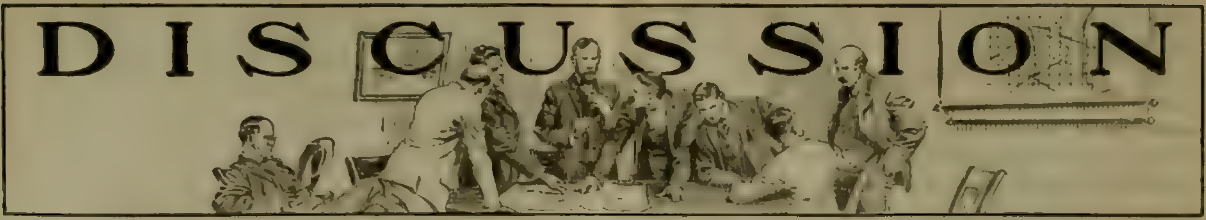
In those cases in which backward countries possess important mineral supplies needed by the world, the Committee can see no escape from the conclusion that demand will make itself felt as a result of political pressure from without. Then a joint action by governments to secure equal opportunities for all nationals is favored. If circumstances require that pressure be brought by one government, the end to be sought should be the development of the territory, not only for the benefit of the government bringing the pressure, but for all nationals. Disregard of this principle has been the cause of much friction. The government of the United States is urged to maintain a close touch with American activities in foreign mineral regions. This might be accomplished by appointing mineral specialists as diplomatic attachés or as consular agents or as agents of the Department of Commerce in countries where raw minerals play a part in international relations. More systematic reports should be sent to the home government, and more attention should be paid by the home government to the interpretation and the correlation of these reports, in order to determine which of our foreign activities in minerals are essential to the national welfare, to ascertain the force and practical application of the mining laws of such countries, and to advise and to protect American companies operating abroad. Such information should be at the disposal of all citizens interested in mining development. Intelligent co-ordination and supervision of the problem by qualified and responsible officials of the home government would be greatly to our interest; at the same time it would tend to obviate discord. In cases of international dispute, and there are many such relating to minerals, the desirability is emphasized of appointing committees composed of specialists from the countries concerned to ascertain and to present the essential facts as a basis for negotiation. For instance, some of the recent diplomatic discussion in relation to the exploitation of oil in foreign countries has been complicated unnecessarily by differences in the statement of fundamental geologic facts of distribution; this might be avoided by an international conference of qualified experts. The surveys of the world's coal and iron resources, made by the International Congress independently of government aid or influence, have served a useful purpose; they are excellent examples of what may be accomplished by disinterested scientific inquiry.

The United States has been endowed with mineral resources to an extent not equaled by any other country; it is utilizing these resources in such a manner that the annual mineral production of this country is nearly two-fifths that of the world. Exploration undoubtedly will disclose further large reserves; but conditions are sufficiently well known to warrant the belief that the extent of such in the United States can be estimated with a reasonable degree of accuracy. It is clear that we have, and will continue to have, a valuable exportable surplus of copper, coal, iron and steel, phosphates, silver, and sulphur; and, in view of recent discoveries, borax may be added to the list. There is no reason why these minerals should not be exported, for the prosperity of the industries in question may depend largely on the maintenance of outlets to foreign countries, which should not be closed by restrictions necessitating local conversion and fabrication in those instances in which costs would be excessive; or by means of import taxes that would invite retaliation on minerals of which the supply is deficient. The export of coal from the United States is a natural consequence of large supplies, the needs of other countries, and our ability to produce more efficiently and more cheaply than can other coal-exporting nations. On the other hand, the supplies of many important minerals in the United States approximately balance domestic requirements; small amounts are imported and exported because special grades are needed, because of cheaper production elsewhere, and for other reasons. The importation of such minerals is not essential, however; no compelling reason exists for the opening of channels of international movement or for closing them. The inclusion of oil among minerals of this class, in which this country is almost self-supporting, requires explanation and qualification. The United States leads the world in oil production, but it also leads in consumption. If the exportation of refined products were avoided, the country could probably manage with the domestic production. As it is, however, imports from other countries, particularly from Mexico, have been necessary during recent years to balance the export of refined products. The industry is on such an efficient basis that the United States is able to perform a service to the remainder of the world in gathering and distributing this product. It seems desirable, in order to continue this service, that channels of import and export be kept open. Further, it is probable that future domestic production may not be sufficient for the domestic demand; this constitutes an additional reason for maintaining channels of import. In the exploration and development of oil resources, American initiative and capital have proved efficient; they should be allowed the fullest latitude, both at home and abroad, thus ensuring adequate supplies for home consumption as well as for refinement and export to the remainder of the world. The Government can aid in securing and preserving the necessary privileges. Self-interest plays so large a part in seeking these opportunities that the Committee deplores unfavorable criticism of other nationals that desire similar advantages.

The United States will be dependent on foreign sources for a considerable proportion of its supply of antimony, asbestos, ball-clay, kaolin, chalk, chromite, corundum, garnet, certain grades of graphite, manganese, mercury, mica, monazite, Naxos emery, nitrates, potash, precious stones, pumice, tungsten, vanadium, and zirconium; it will, as in the past, depend on other countries almost entirely for nickel, cobalt, platinum, tin, and diamonds. Future exploration in the United States may disclose adequate supplies of some of these minerals; but for the most part it is believed that conditions are sufficiently well known to make this unlikely. With certain exceptions, any attempt by legislation to exclude foreign supplies and to make the domestic production of these minerals suffice for the United States will not succeed, except at the cost of enhanced price and lowered efficiency. Such a course would also mean the depletion of our limited national resources—a course that may seriously endanger the country at a time of critical need. In the meantime, governmental restrictions on imports, which will probably induce retaliatory measures abroad, are likely to make it more difficult for American enterprise to find and to develop the needed supplies of such minerals in those foreign countries where geologic conditions are favorable. So long as import channels are not closed, the Committee does not oppose tariffs or other measures designed to offset differences in the cost of living and to aid in maintaining the nucleus for an industry that might be useful in time of crisis. Luxuries, such as diamonds and platinum used for jewelry, may well afford to pay import taxes. The Committee favors protection of industries concerned with the mining of domestic minerals that are known to exist in large quantities, capable of efficient utilization, but handicapped by competition with foreign supplies. In such cases, careful consideration should be paid to the possibilities of adapting low-grade reserves to our needs, in order to find if feasible and efficient processses can be developed to ensure production at a reasonable cost. If so, some measure of protection would be justified. For instance, there are extensive deposits of flake graphite in the United States, but in many of these the fineness of texture is a handicap; it is said to make the material undesirable for one of its principal uses—the manufacture of crucibles. Experience during the War indicated that the American grades could be used to a larger extent than had been anticipated; but, with the resumption of peace conditions, foreign supplies again dominate the market. Without definite commitment for or against a tariff, it is suggested that a case of this kind affords a reasonable field for investigation as to possible protection.

The statement of principle made by the Committee in this report emphasizes the need for considering the natural distribution of minerals in determining international trade; it does not attempt to cover all the qualifying economic factors involved. The facts are presented primarily from the point of view of the self-interest of the mineral industry of this country; but such considerations are also vital to the preservation of friendly international relations. An understanding of the elementary facts as to the geographic distribution of minerals and the need for importation and exportation will serve to minimize friction. The interests and ambitions of the various branches of the mineral industry are so extremely diverse, and each group of exploiters is so insistent, that it is difficult to discern what are the underlying aims and principles of the industry as a whole, if there be any. Those engaged in the industry are, presumably, well qualified to speak on these matters; and yet to the public their representations must sound like a babel of special interests. This is perhaps an inevitable consequence of scattered geographic development; but the industry has now reached such large proportions and so often overlaps national boundaries that the formation of a united policy is of vital national concern. The report will serve as an admirable foundation for a detailed study of the subject.

DISCUSSION



Valuing Partly Exhausted Mines

The Editor:

Sir—I have read the discussion on my article on the above subject appearing in your issue of April 9, 1921, and have to extend many thanks to Messrs. John A. Burgess, Milnor Roberts, L. S. Ropes, John A. Rice, and L. O. Howard for their valuable contributions.

To attempt to deal satisfactorily with each contribution would occupy too much space. I will, however, take the liberty of commenting on some of the more important points, as they appear to me, without reference to whether they are complimentary or otherwise.

Professor Milnor Roberts states: "An entirely new chapter may be suggested with the title 'Examining Mines Partly Exhausted by Nature'. This is to the point. If I understand the Professor correctly, reference is made to the large number of ore deposits that have been partly eroded away. He states further that in many cases erosion has exposed the best part of a deposit. The first statement is a fact, and the second appears to me as a novel and intelligent assumption. It has, moreover, the merit of economic importance.

It is easy to imagine an ore deposit where the better portions owe their existence to more porous and friable country-rock. The replacement of wall-rock would, in some cases, bring about a friable and weakened condition. Subsequent erosion could result in making gullies in the country-rock by selecting lines softened by the above means. This could account for a number of base-metal mines that under even superficial development have proved disappointing.

However, I feel that the value of Professor Roberts' observations would be impaired if the suggestion was not confined to the particular deposits in which this condition is mostly likely to occur. I am not in favor of a general application of the theory; and I do not gather that the Professor suggests its wide application. It would not account intelligently for the great mortality in gold mines which I consider is due to differential enrichment: the leaching out of solubles, leaving the gold untouched and therefore in fictitious proportion to the original ore-mass. Such a mine becomes quickly disappointing when development intersects the unoxidized horizon.

I do not think the theory would apply except in a limited way to silver mines of the recurring ore-shoot type, because many shoots in this class are 'blind', that is, they do not come to the surface. An excellent example is the Las Chispas silver mine, in Sonora, Mexico. Many of the best shoots either do not come to the surface at all, or only the tips are exposed. Should, however, the famous El Tigre silver mine (in the same State), which has an unbroken ore-shoot of 5000 ft., be situated in areas of former glaciation, it is easy to imagine a large part of such a deposit being eroded. As Professor Roberts aptly says, "Often, however, the erosion has progressed to a stage corresponding to the working out of the upper levels of a mine, for the upper portion of the deposit and the country-rock enclosing it have been wholly removed, leaving the orebody exposed at its heart".

I believe that the base-metal deposits have been damaged most by erosion. For example, at Butte a large north and south fault, called the Continental fault, passes through the easterly portion of the district. This fault is post-mineral and the vertical displacement is estimated at roughly 1000 ft.; the west side being the downfallen portion. Good surface indications not only in extensive outcrop, but also in sulphide ore, are found on the east side of the fault.

I was identified, some years ago, with the development of an attractive prospect east of Butte. The property had large outcrops and a comparatively high-grade copper sulphide showing on the first level. Development below this level was undertaken, and it proved disappointing. The possibility of erosion had not been generally considered at that time, and the 'East side' was regarded by engineers and geologists familiar with the district as containing a possible extension of the famous Butte orebodies. A search for the reasons causing the disappointing experience led me to conclude that at one time the east side was left 1000 ft. above the general level, and as the surface is now only a gentle slope, only the 'stumps' of the ore-shoots remain. This theory is supported by the fact that in the Butte 'flat', as I remember it, there are several hundred feet of detritus.

In reference to the contribution by Mr. John A. Burgess, he has misunderstood certain facts in regard to my examples. In the examples of four actual mines offered in my article, it was impossible to anticipate all the points raised by him. To have done this would have amounted to publishing detailed reports on all four mines. In the space of an article this was not feasible. The possibility of parallel veins and horizontal extensions were all considered in the actual examinations, but it must be evident that to have gone into this would have impaired the 'line' of my article. This was the intelligent dividing of the exploration of partly exhausted mines into three finance budgets, based on a decreasing risk which progresses in the form of an anti-climax. Mr. Burgess' observations, however, are of value if studied in conjunction with my examples, as by this means a reader is made aware of the many points necessary in estimating the three classes of decreasing risk, which I described as 'initial', 'intermediate', and 'mine'.

Mr. Burgess, however, says further, "I question the statement of Mr. Webber that a mine should be able to earn 7% on the cash investment. This seems inadequate. An annual return of 15% is a common demand, but in the case of short-lived mines, it should be larger". This was not what I said. If reference is made to my article, Mr. Burgess will see that I say that a base-metal mine should be able to earn 7% on the 'split' between the average of the metal for the preceding 15 years and the average of the low peaks for each year for 15 years. This is a very different thing. Everything obtained from metal sales above the 'split' line would be strictly net, all the costs having been debited and the mine required to earn 7% on the 'split'. If actual examples be taken, it will be found that on the average metal market, a mine valued on my basis would yield from 15 to 30%, depending on the ratio of output to capitalization. No doubt, Mr. Burgess will be the first to admit he has misquoted me to a point that makes me appear ridiculous. A person who would be content with 7% would ignore even the elementary principles of a mining risk. My original text will speak for itself.

Mr. L. S. Ropes asks questions which are strictly geological. His questions, I think, apply to particular mines and in varying degrees, and in many cases not at all. He states, "It would be interesting to know something of the relation of the ore deposit to its country-rock, its relation to eruptive or igneous occurrences and to sediments. It would be interesting to know if the hydrated gangue is to be considered as an alteration product from the unaltered bull quartz below, or may we assume that there was a marked change in the gangue of the lode between these points?"

Mr. Ropes says further, "The impression one gathers from Mr. Webber's discussion is that the decision has rested with the diagnosis based on sampling alone". This statement is not warranted if reference is made to my original text. I said, "Unless there is collateral evidence of neighboring operations, the exhausted portions of the deposit are the only index to the possibilities of the future". This surely does not indicate the observations of an engineer who bases everything on sampling. Such a person would be a failure as a mine-valuer because he could only understand what he could sample. He would lack both imagination and the faculty of retrospection. He would, moreover, lack what in my article I describe as a prime essential of the valuing engineer, "balanced optimism". On the contrary, in my article I advocate using the past performance of a run-down mine as one of the touchstones to gauge what it may do if taken over by a capable and financially able people, and my attitude seems clear to Mr. John A. Rice, who says, "Most certainly, we all agree with Mr. Webber in the statement, 'Theoretically it is better business to buy a gutted mine with a good bottom than the same mine with an important quantity of remaining ore above the lowest level' ".*

Turning now to the excellent contribution by Mr. John A. Rice, reference is made to two points that appear to me well worth repeating, as they support what I have so often emphasized: that ore-reserves and the future possibilities beyond development exposures are distinct propositions; also that formulas are of little use in the appraisal of the life-extension of mines. Mr. Rice says:

"I wish to point out what Mr. Webber does not specifically mention, that an exhaustive study of all the available geologic data will often answer the question as to whether it is probable that the mine is worth the price asked or not. These data, as Mr. Webber says, are entirely distinct and sometimes independent from those of production records or of blocked-out ore, and may lead to a final decision regarding the probable future value of the property without consideration of the historical records. In other words, the exhaustive study of the geological data available may absolutely limit the value of the property to that of the ore in sight, or, on the other hand, suggest probabilities that will place the value of the assured ore in a comparatively insignificant relation. Without an exhaustive study of the geological situations, it is impossible to arrive at a proper valuation of any mining property regardless of the story told by the ore in sight or production records."

Another paragraph in this contribution is as follows:

"May the time soon come when the vendor will be willing to wait a reasonable time for his money, while the buyer, with the faith of his convictions based on geological interpretations, develops new ore with which to pay for the mine, the while he pays expenses out of ore in sight, to ultimate advantage of all concerned. May we soon see eliminated the vexed situation in which cash payments are demanded for ore in sight, while the purchaser depends upon the false safety promised by the blocked-out ore. The value of a partly gutted mine usually depends more on the undeveloped ore than on the ore in sight, and not at all on the value of the ore already mined."

I am also obliged to Mr. L. O. Howard (October 22), and appreciative of the complimentary things he says. He, however, attempts to show that my assumptions, based on Case B, page 389, of my article, are unwarranted. This may be so, but I maintain that Professor Howard is now using 'hindsight'. He attempts by a geometrical formula to show that what finally happened in the exploration of this property could have been foreseen. I may be wrong, but I doubt very much if the Professor would have used his formula if he had accompanied me on the original examination. The bottom level of this mine contained a greater length of ore than on any level above. I cannot imagine, in view of these data, that the Professor would attempt to persuade me to throw up the venture. At all events, I would not have listened to him. After opening up the 800-ft. level, the lowest level of the mine (an item of considerable expense) and finding a longer horizontal length of ore than any level above, and in the face of these data, to have rejected the proposition, would have left it open to others who certainly would have taken the exploration in hand. Had they been successful, I would have had the worst type of blunder to 'live down', namely, condemning a good chance and keeping a client out of a profitable investment. It further appears to me that Professor Howard's formula would only hold good provided an ore-shoot maintains its dip, or continues to flatten. If it commenced to steepen, it would throw all his deductions out.

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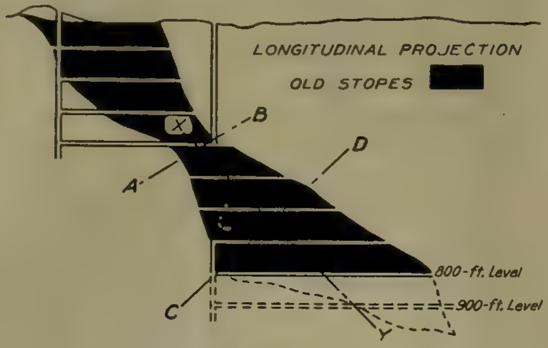
*The reasons furnished in the original article for this statement were that in the case of a mine with a large ore-reserve coming on the market not only would the vendor demand a large payment for the ore-reserve, but that more would be demanded as the price to be paid for the future possibilities, notwithstanding the fact that a large intact ore-reserve would have no bearing on the future possibilities beyond exposures. A large ore-reserve would also demand a form of purchase whereby the payments would mature so quickly that the vendee would become heavily involved in the deal before he had time to explore the prolongation of the ore deposit.



EXAMPLE B

I note that my proposal for dividing the development of a prospect or a partly gutted mine into three development programs, each having a definite finance budget, has met with general approval. This was the essence of my article. I felt it furnished a business-like method of 'cutting a loss', based on engineering data; it had such elasticity that the extent and nature of the development to be undertaken was governed by data obtained by the preceding budget, and it prevented 'following a loss' by throwing good money after bad.

Morton Webber.

New York City, December 22, 1921.

Cajon

The Editor:

Sir—At the Colquijirca mine, not far from Cerro de Pasco, in Peru, and at some of the smaller mines in the latter place, the term 'cajon' is used in two different ways. When it is desired to distinguish them, they are called *cajon de medida* and *cajon de ley*.

The *cajon de medida* is a box-measure containing about half a cubic metre and it is used in measuring the ore mined by contractors, usually working independently on a small scale. The box has four sides but no bottom, is set upon a level place and filled with the ore as it is brought out of the mine. When the box is full, the frame is lifted and the ore runs out of the bottom; the top of the pile is then leveled off and the box set upon it for a second filling.

The *cajon de ley* is used only to express the grade of the ore. It amounts to three Spanish tons or 6000 pounds, and the assays are expressed in *marcos por cajon*, usually written m/c. A 'marco' is equivalent to one part in 12,000. This information is from notes that I took some time ago at Huaraucaca, Peru, in a conference with Mr. Antenor Rizo Patron, an eminent Peruvian mining and metallurgical engineer. Gubbins' mathematical tables, published at Lima, Peru, give 920.186 kilogrammes as the equivalent of one Spanish ton.

I am writing this on the chance that you may wish to use the information in connection with the discussion of the subject and the contribution from Mr. Söhnlein, who tells about a different practice in Chile.

Boston, January 18. W. Spencer Hutchinson.

The Codding Process

The Editor:

Sir—I note in your issue of January 7, the reference to the Codding process for treating complex ores. Although holding no brief for Denver, which you mention as the home of the process, it is my understanding that the process, if such it may be called, actually originated in your own Los Angeles. Some two years ago a Mrs. Codding was in Boston and managed to interest a local investor in her reputed process for treating complex ores. I was asked to investigate the matter, and met Mrs. Codding. It was painful to have to listen to her extravagant claims, which were that she could treat any refractory gold and silver or quicksilver ore and obtain a complete recovery. We tried her out on a concentrate from a Nova Scotian gold ore, and after one trial, she never came back, for reasons which were obvious to me when I assayed the tailing.

We went far enough to demonstrate what was obvious on first sight, that is, either that one or both of the people who brought the process to us were frauds or, what was equally likely, that they were entirely devoid of any metallurgical experience, knowledge, and sense.

Cambridge, January 13. Edward E. Bugbee.

The Engineer

The Editor:

Sir—At Melbourne in a post-lecture discussion on this subject, the talk had become tedious to one or two of us, so I butted in with "What the devil is an engineer, anyhow?", and I suppose the tone was impertinent. Prof. W. C. Kernot had as sweet a disposition as any man I ever knew, but if you did get under his hide you got something. He turned round and answered in a flash, "My boy, an engineer is a man who can do for £5 what anyone can do for £10"; and that is more than I've heard before or since, and from my point of view finished the discussion.

A. L. Blomfield.

Colorado Springs, December 23.

Cold-Water Thawing of Frozen Gravel

By Edward E. Pearce

This is a description of a new process for thawing frozen gravel by means of cold water, showing the methods employed and the results obtained by Iver Johnson and myself on a piece of dredging-ground on Candle creek, Alaska. Mr. Johnson and I were the first to apply the use of the small pipe in cold-water thawing operations. Prior to our use of 100 half-inch cold-water points ahead of our dredge, three holes had been drilled near Nome. Pipes of 2½ in. diameter were inserted in these holes, and cold water was used for thawing.

During the summer of 1918 we thawed a shaft 30 ft. deep. This shaft was used for cold storage, and the first 25 ft. was in 'muck', or frozen vegetal mud. In the same year we used 40 cold-water points, each of ¾-in. diameter, and dredged the ground so thawed. In 1919 we used 100 half-inch cold-water points, set up in units of 25 points to each unit, and dredged the ground so thawed. It was during these years of experimenting on a working basis that we discovered this new process of thawing. We proved, by dredging it, that the ground had been thawed by the new process; and we found that it not only reduced the cost of thawing, but eliminated all the many elements of uncertainty attendant on thawing by any other method on a large scale. We did enough thawing with cold-water points to know the weaknesses of our system, and we saw that in deep ground it would be only indifferently successful. Some other method would have to be employed.

The following is a description of the new process: Fig. 1 shows a general plan of the ground *A′*, *A′*, *A′* being the portion that had been dredged previously; and *B′*, *B′*, *B′* the ground desired to be dug. This ground is perpetually frozen. It has no muck on the surface, but there is a layer of muck two feet above bedrock.

In order to confine our thawing to the area that we intended to dredge, it was necessary to turn the water of the creek *C′*, over the area *B′* instead of letting it run over *A′*. Down the stream at *D D* a bar of gravel rose two feet above the water; and in order to get our seepage to the limits of this bar, which we were to dig, we dug a shallow ditch on each side, as shown at *E* and *E′*. Our thawing-area would be then confined within the outside edges of these two ditches. If we had not dug this ditch at *E*, for instance, all the ground between the shaft *F* and the side *E* would have remained frozen, as the seepage to the shaft would all have been from the water side *E′*. It is therefore important first to block off the area to be dredged, and then see to it that there is surface water at the extreme edges, for no thawing will take place beyond the limits of this surface water.

F is a shaft sunk into the bedrock, *F′* the suction, and *F″* the pump-discharge. *G* is a 2½-in. rotary pump with a rated discharge of 250 gal. per minute, and *H* is a 4-hp. Cushman gasoline engine. The numbers 1 to 46 repre-

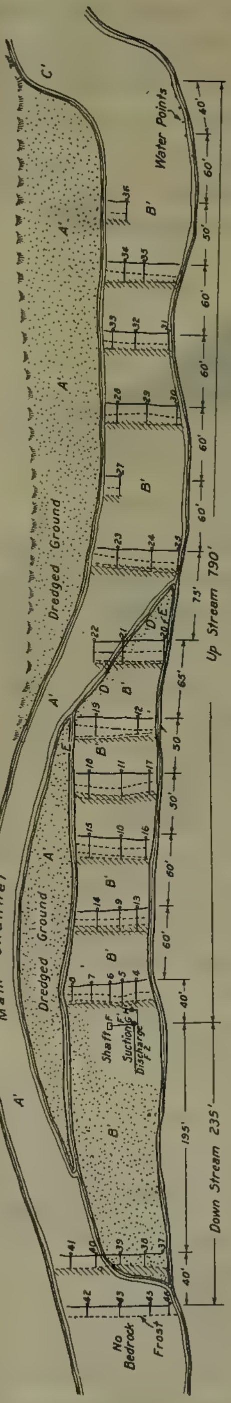


FIG. 1. PLAN SHOWING THE GROUND THAWED

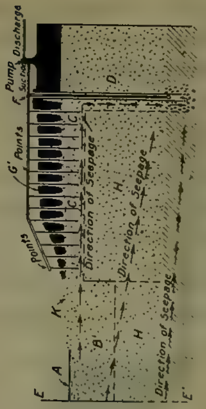


FIG. 3. CROSS-SECTION OF SAME

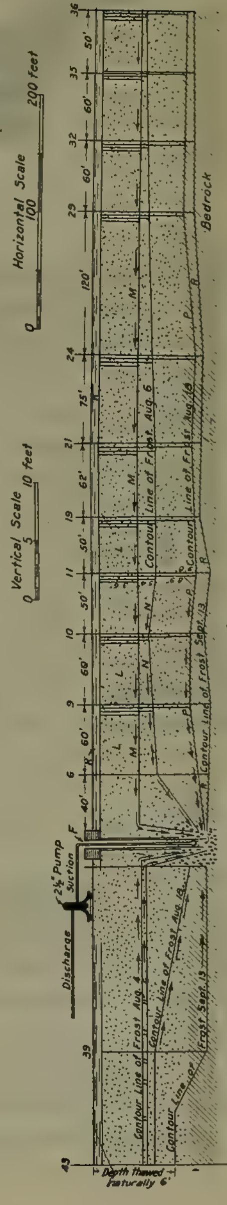

Horizontal Scale
0
100
200 feet
Vertical Scale
0
5
10 feet
Bedrock
Contour Line of Frost Aug. 6
Contour Line of Frost Aug. 18
Contour Line of Frost Sept. 13
2½″ Pump Suction
Discharge
Contour Line of Frost Aug. 4
Contour Line of Frost Aug. 18
Contour Line of Frost Sept. 13
Depth thawed naturally 6′

FIG. 2. LONGITUDINAL SECTION OF THE THAWED GROUND

sent test-holes driven at different times to determine the depth that the line of frost has been moved downward. The broken lines are the contours of frost at different dates. The cross-sections along these test-holes are represented as being taken up in place and laid horizontally on the surface of the ground.

Fig. 2 is a section taken longitudinally above and below the shaft; it shows the contour lines of frost at different dates, and also the direction of the seepage. A shaft 5 by 5 ft. and 9 ft. deep is sunk at *F* into the bedrock. It is timbered tightly down to within about two feet of the bottom, and is also extended above any surface water, the whole purpose being to permit no water to enter the shaft except from the bottom. Around the sides and at the bottom some coarse gravel is thrown, to keep the fine from filling in. The shaft will fill immediately with water to the water-level. The suction of the pump is dropped to within about 1 ft. of the bottom of the shaft, and the water from the shaft is exhausted. As fast as this is being done, the creek-water *K*, seeping through the thawed surface area *L*, follows along the frost-line *M* to seek its own level in the shaft *F*, thus making a continuous flow of fresh water over the surface of the frost. As this operation is continued, so will the frost-line be moved downward until it has reached the level of the bottom of the shaft. The only limits to this system of thawing, up-stream and sideways, are the outer edges of the surface water. It may be advisable, however, in certain instances, to sink two shafts. This can be determined only in each individual case.

In our operations last summer, we found on August 4 (the day we started to pump from the shaft) that the seasonal thaw had reached a depth of 3½ ft., as represented by the contour-line *M* in Fig. 2. On August 6 the frost-line had been moved downward to contour-line *N*. On August 18 (the day we stopped pumping) the frost-line had been moved downward through the entire area to be thawed, passing through and thawing a layer of muck, till it had reached and thawed into the bedrock.

The entire area, 790 ft. up-stream and 235 ft. downstream from the shaft, with an average width of 60 ft., had been completely thawed in a period of 15 days, with an actual pumping-time of 80 hours. This ground was dredged during the same summer and no 'horses' of frost were encountered. The ground was thawed well and evenly. The cost per cubic yard to thaw this ground was 1.4 cents per yard, not including any overhead or equipment charges. In many parts of Alaska frozen muck and sod cover the surface of ground that is rich enough for dredging. Anyone who has mined in the North knows that, when this condition is encountered, the cost of extracting the gold will be increased materially, no matter what method may be employed. In our new process this condition will increase the cost of thawing, but not to such an extent as when thawing by any other method is adopted.

Fig. 3 represents a cross-section of a piece of ground of this nature, having the creek *A* on one side, then a bare gravel-bar *K*, and then a gravel-bar covered with frozen muck and sod *G*. It is desired to thaw the ground between *E E′* and the shaft *F*. We do not want to thaw *D*; if we did we should move the shaft farther to the right; *A* is the water in the creek, *B′* the top gravel of the creek, naturally thawed to a depth of 3½ ft., *H H* is frozen gravel, and *G′ G* is frozen muck over the surface of the gravel. A shaft is sunk at *F* into the bedrock. This shaft will remain dry, and no thawing will take place unless a small thawed area *C* is created below the layers of muck. When this area is thawed, a seepage will be maintained from the creek *A* through the artificially thawed area *C* into the shaft *F*. The operations then are the same as they would be were there no muck, as described heretofore. In Fig. 3 cold-water points are used to thaw this area. The points are set in the muck to the top of the gravel only, and are spaced 10 ft. apart. It may be contended that as water-points are used to start the thawing, they might as well be used to complete the operation. This contention is wrong, for it is an entirely different matter to set points to the top of the gravel and to set them in the gravel to a depth of 15 to 40 ft. Furthermore, there is a tendency in ground of this nature for the frozen collars to extend downward into the gravel, and when thawing with points is completed, there is no certainty that no frost 'horses' are left.

Table I—New Process of Cold-Water Thawing

Showing equipment used, cost of operations, area thawed, and cost per cubic yard thawed

Equipment	
One 4-hp. gasoline-engine	$135
40 ft. of 2½-in. pipe	40
Tees and ells	10
Foot-valve and incidentals	30
Lumber for 5 by 5-ft. shaft, 9 ft. deep	85
Total	$300
Labor	
Digging shaft, five men for 1½ days	$60
Pumping, during digging of shaft, one day, one man	8
Extra man, two days	16
15 days pumping from shaft, one man	120
	$204
Distillate used, 106 gal	60
Miscellaneous	25
Total	$289

Area thawed, 790 × 235 ft. by 60 × 9 ft. = 20,500 cu. yd., at a cost of 1.4c. per yard.

Total time plant was in operation	15 shifts
Total time of pumping shaft	89 hours
Average mean temperature of creek	64°F.
Average mean temperature of discharge	48°F.

Table II—Old Process of Cold-Water Point Thawing

Showing equipment used, cost of operations, area thawed, and cost per cubic yard thawed

Equipment	
One 50-hp. Union gas-engine	$3000
One Kingsford pump, 8-in	500
800 ft. of 12-in. hydraulic pipe	1000
1200 ft. of ditch	500
240 ft. of hydraulic hose, 6-in	240
100 ft. of hydraulic hose, 10-in	100
4 units, 25 points each	150
800 ft. of 1-in. pipe	80
1200 ft. of ½-in. pipe	100
700 ft. of rubber hose	400
Tees, ells, unions, valves, etc	100
Total	$6170
Labor	
One point-man, 30 shifts	$300
One helper, 30 shifts	240
One engineer, 25 shifts	250
	$790
Distillate used, 500 gal	300
Miscellaneous	50
Total	$1140

Area thawed, 450 × 80 × 9 ft. = 12,000 cu. yd., or 9½c. per yard.

Comparative Statement of Tables I and II

	Cold-water point method	New process
Cost of equipment used	$6,170	$300
Cost of labor	790	204
Cost of oil	300	60
Miscellaneous	50	25
	$7,310	$589
Area thawed	12,000 cu. yd.	20,500 cu. yd.
Cost per cubic yard thawed	$0.095	$0.014
Average thaw per shift	400 cu. yd.	1,366 cu. yd.
Time of plant in operation	30 days	15 days

Metal Output of California in 1921

According to estimates by J. M. Hill, of the San Francisco office of the U. S. Geological Survey, the metal output of California in 1921 was approximately 761,660 oz. gold, valued at $15,744,910; 3,514,276 oz. silver, which under the Pittman law was worth nearly the same number of dollars; 11,681,705 lb. copper; 779,298 lb. lead; and 842,400 lb. zinc. The production of these metals in 1920 was, gold, 692,297 oz., valued at $14,311,043; silver, 1,706,327 oz.; copper, 12,626,272 lb.; lead, 4,813,510 lb.; zinc, 1,165,509 lb. The figures reflect the trend of mining during 1921. The market for copper, lead, and zinc was so poor that few mines that make these metals their major product were in operation. A little lead ore rich in silver was mined, as well as some zinc ore, which was converted into zinc oxide. On the other hand, the mines that produce mainly gold or silver were active throughout 1921, and numerous mines were re-opened during the year. The signs of revival were evident in the spring, and by midsummer there were almost daily rumors of gold mines either being re-opened or under development. The greater part of the silver produced can be credited directly to the mines near Randsburg that are grouped about the famous Kelly mine.

For a time in July it looked as if the mines along the Mother Lode, particularly those near Nevada City and Grass Valley and among the largest-producing deep mines in the State, might be forced to close because of labor troubles. These troubles, however, were finally adjusted, and a wage-scale was established to hold until June 30, 1922. This scale, $4.25 per day for machinemen and $3.75 for shovelers, has been more or less generally adopted throughout the State. In the northern counties the copper-smelting town of Keswick has almost disappeared and is replaced by Matheson, 3 miles farther north, where the tram from the Hornet mine of the Mountain Copper Co. has its terminal. At Bully Hill the Shasta Zinc & Copper Co. has built a zinc-oxide plant to handle the ores of the Bully Hill, Rising Star, and Copper City mines. Several of the less well known properties at French Gulch, Coffee Creek, Igo, Etna Mills, Humbug, and Yreka were re-opened late in the summer. A new dredge was launched by the Gardella Dredging Co. to work near Lewiston, on Trinity river. With the re-opening of the old Juniper mine at Hayden Hill, Lassen county, prospecting revived. In Plumas county the properties of the Engels Copper Co. continued successful development. In Sierra county the Original Sixteen to One and Tightner mines continued to extend operations. The Kate Hardy, at Forest, built new surface equipment. The revival was also felt in Butte county, where several deep and placer mines were resuscitated. In Amador county the Kennedy and Argonaut mines resumed production, after a successful fight against fire and water that tied them up for many months. The Plymouth and Central Eureka mines developed good ore in the lower levels. The Moore mine, at Jackson, was re-opened after an idleness of 20 years. In Calaveras county the Morgan mine has developed a large quantity of ore, and the 30-stamp mill was in continuous operation. A fire at the Sultana mine, in Angels Camp, destroyed all the surface equipment. Several of the mines at French Camp, Murphy, Melones, Mokelumne Hill, and West Point were re-opened during 1921. In Eldorado county the Havilah mine, at Nashville, was a steady producer, as was the Golden Unit at Placerville. The Grit mine, at Georgetown, and the Rising Sun, at Colfax, Placer county, were added to the list of producers during the year. Nevada county, which contains the Empire, North Star, and Idaho-Maryland, all producing mines, was as active as any of the mining counties of the State. The Allison Ranch mine, however, was closed down, but the Alcalde, Bullion, Union Jack, and Norambagua were re-opened. The Belmont-Shawmut, at Shawmut, Tuolumne county, was a steady producer; the Eagle Shawmut and Magente, at Jamestown, were re-opened, as was the Rawhide, at Rawhide, and the Patterson, at Sonora. The once-famous Princeton, Pine Tree, and Josephine mines, in the Mariposa Grant, Mariposa county, were bonded to strong companies and will soon be producing.

There was some development in western Kern county, though naturally the greatest interest there is centred about the silver mines near Randsburg. The revival of this camp was spectacular and included many of the gold mines, among them the Yellow Aster, in which several sets of lessees have been working throughout the year. San Bernardino county and the other desert counties were hard hit, for their mines produce mostly copper-lead-zinc ores, for which there was almost no market. The operations at Darwin closed suddenly about midsummer, but the Cerro Gordo, Santa Rosa, Slate Range, and Estelle shipped some ore. On the whole, the outlook is encouraging, for if only a small number of the many enterprises started near the end of 1921 mature, the year 1922 will witness much more mining activity throughout the State than has been known for some time.

METAL mines in New Mexico, according to C. W. Henderson, of the U. S. Geological Survey, produced in 1921, $184,000 in gold, 671,000 oz. silver, 500,000 lb. lead, 14,460,000 lb. copper, and 20,000 lb. zinc, as compared with $480,302 in gold, 768,042 oz. silver, 2,869,525 lb. lead, 54,400,691 lb. copper, and 10,013,580 lb. zinc in 1920. These figures indicate that during 1921 only ores carrying a considerable amount of silver could be mined profitably.

Investing in Copper Shares

By Arthur B. Parsons

One of the familiar figures in the lobbies of the Waldorf for many years prior to his death in 1913 was an old gentleman known as Captain Fleming, reputed to be worth anywhere from 15 to 25 million dollars. He had acquired his title in the early days when master of a steamboat on the Mississippi river, he started to accumulate a fortune in the lumber business in Michigan, and had added to it by fortunate speculation in sundry mining ventures in the Western States and in Mexico; in fact, his interest had become centred in mining to the virtual exclusion of everything else. During the 15 years that he was a residential guest at the hotel he never lost an opportunity to listen to the story of any visiting engineer or promoter who was inclined to talk about mines. Few of them were able to sell him anything, but he was a good listener and a shrewd questioner, so that generally the promoters got a fair return for their conversation, by having pointed out to them the features of their proposition that appealed to the old captain as being weak. His executor found more than a million in high-class railroad and industrial bonds, a few shares in established and producing mining companies, and an unusual dearth of those handsomely lithographed and totally valueless mining-stock certificates that most rich men are wont to accumulate.

The worthy captain had one pet idea; he did not thrust it upon anyone but he gave it freely to those who asked for advice. His theory was to the effect that there are only two classes of people who have any business to put their money into mining. In the first class is the man whose financial resources are comparatively meagre; he cannot lose much anyhow, and he may win; in the second is the man who has so much money that he can afford to throw some of it away if the whim should strike him. Somewhat cynically, perhaps, the captain argued that the small purchaser of mining stock took a double chance: first he had to gamble with the vagaries of Nature—as to how much ore, if any, she had put in the mine and as to where and how she had distributed it; and secondly with the frailties of mankind—as to how honestly and how capably the management would conduct the enterprise. It is undeniable that hundreds of millions of dollars have been lost by 'outsiders' in trading in the stocks of really good mines; gross mismanagement has ruined some mines; and Nature herself has been guilty of holding forth encouragement only to disappoint honest miners. In addition, there have been simple swindles in which the promoters themselves would have been astonished by a twist of fate whereby they found themselves in control of a real 'mine'. Unfortunately, unscrupulous men are still trying to get rich quickly by exploiting the public; and greedy and ignorant people are still trying to do the same thing by purchasing stocks that they are told may earn them astonishing profits. The mining industry is by no means the only one that offers opportunity for fraudulent promotion and rash speculation, but the inherent element of risk, with the possibility, even if remote, of winning great wealth, makes it particularly suitable for fraudulent operations.

Need for Careful Analysis of an Enterprise

One characteristic peculiar to mining enterprises is the fact that ore-reserves are a wasting asset. When a ton of ore is mined and milled there is nothing to replenish the supply. This makes it essential that the rate of dividends be sufficient not only to pay interest on the money but to provide for the return of the capital investment before such time as the mine becomes exhausted. While it is entirely practicable to take this factor into consideration in appraising the value of shares, it is a fact that this phase of mining is ignored sometimes by investors. It emphasizes the need for the closest scrutiny of investments in mining securities. All things considered, it is fair to say that there are no metal-mining companies whose shares afford a desirable investment for those symbolic objects of financial solicitude—the trust funds of widows and orphans; at the same time even the conservative investor can scarcely endorse the view of Captain Fleming that only the comparatively impecunious or the exceedingly plutocratic are justified in purchasing at a fair price shares in many of the mining enterprises of today, more especially those of the well-established copper-mining companies, with which this article is to deal. It is essential, of course, that the particular enterprise under consideration be analyzed as any other business ought to be analyzed; but the too prevalent theory that the purchase of any mining stock is a bald speculation, having none of the elements of a sound investment, is no longer tenable.

Trend of Market Prices

During the War the market price of copper-mine securities rose to unprecedented levels, and, in 1921, with the suspension of operations and of dividends, the reaction precipitated many of them to a figure less than half the peak price. During recent months the pendulum has commenced to swing back; the quotations on some of the shares show that a profit of 50% or more could have been realized by purchasing six or eight months ago and selling today. The fascinating question arises, is an investor justified in purchasing these shares now at the prevailing market price? Will the war-prices for the shares be reached again? Doubtless the answer is different for stocks of different companies. Without attempting to express a direct opinion I shall endeavor to point out some

TABLE I. STATISTICS REGARDING IMPORTANT COPPER

Name of company	Location and type of deposit	Capital outstanding	Shares outstanding. Par value	Excess of current assets over current liabilities and excess per share, December 31, 1920	Total reserves for depreciation and depletion (a)	Production in millions of pounds and net cost in cents per pound Year	Millions	Cents
Ahmeek	Michigan	$5,000,000	200,000	$3,285,389	Depletion and	1913	[illegible]	13.30
	Lode		$25	$16.18	Depreciation 3,149,272	1914	14	9.71
						1915	22	7.96
Anaconda	Montana	$116,562,500	2,331,250	$67,861,301	Depreciation ...$22,310,820	1913	270	10.50
	Vein	Bonds, $50,000,000 (c)	$50	$29.11		1914	223	10.50
						1915	254	10.50
Braden	Chile	$12,953,530	2,590,706	$10,187,486	Depletion 7,374,983	1913	..	...
	Massive	Bonds, $15,000,000	$5	$4.06		1914	28	...
						1915	32	8.78
Calumet & Arizona	Arizona	$6,425,210	642,521	$8,477,093 (e)	Depletion 7,387,200	1913	53	7.65
	Vein		$10	$13.19	Depreciation 1,493,169	1914	53	8.19
						1915	65	8.00
Calumet & Hecla	Michigan	$2,500,000	100,000	$12,901,088 (f)	Depletion and	1913	45	14.25
	Lode		$25	$129.01	Depreciation 13,724,820	1914	53	11.35
						1915	71	9.33
Cerro de Pasco	Peru	898,230 shares	898,230	$7,867,144	Taxes 619,309	1913	44	8.50
	Vein	Bonds, $8,000,000	Par nominal	$8.76	Depletion 18,011,655	1914	46	8.50
					Depreciation 3,118,709	1915	60	9.00
Chile	Chile	$95,000,000 (i)	3,800,000	$25,407,758	Depletion 7,098,558	1913	..	...
	Massive	Bonds, $50,000,000	$25	$6.69	Depreciation 10,690,523	1914	..	...
						1915	..	...
Chino	New Mexico	$4,349,900	869,980	$3,960,837	Development ... 1,179,987	1913	51	8.79
	Massive		$5	$4.55	Depreciation 2,703,846	1914	54	7.60
						1915	65	7.12
Copper Range	Michigan	$9,859,075	394,363	$5,437,488	Depletion and	1913	19	11.71
	Lode		$25	$13.79	Depreciation 2,432,385	1914	20	10.66
						1915	37	8.06
Easte Butte	Montana	$4,242,820	424,282	$1,048,343	Depletion 653,699	1913	14	11.04
	Vein		$10	$2.46	Depreciation 65,164	1914	9	11.11
						1915	13	11.85
Granby	British Columbia	$15,000,420	150,004	$106,613	Depletion 6,679,453	1913	23	10.60
	Vein	Bonds, $1,491,400	$100	71c.	Depreciation 2,994,796	1914	23	11.50
		Conv. 6%, due 1928				1915	27	10.66
Greene-Cananea	Mexico	$50,000,000	500,000	$6,902,310	Depreciation 528,733	1913	44	9.63
	Vein		$100	$13.80		1914	22	10.72
						1915	16	11.09
Howe Sound	British Columbia	$1,984,150	1,984,150	$3,189,535	Depletion and	1913	13	...
	Vein	Bonds, $4,035,000	$1	$1.60	Depreciation 7,544,265	1914	12	...
		6%, due 1936				1915	[illegible]	7.50
Inspiration	Arizona	$23,639,340	1,181,967	$9,218,531	Depreciation 3,247,352	1913	..	...
	Massive		$20	$7.81	Development ... 1,565,038	1914	..	...
						1915	20	8.14
Kennecott	Alaska	2,787,081 shares	2,787,081	$22,814,923	Depletion 30,098,587	1913	..	...
	Vein	10-yr. 7% gold bonds	Par nominal	$8.55	Depreciation and	1914	..	...
		$15,000,000			Development ... 5,960,921	1915	63	4.54
Magma	Arizona	$1,500,000	300,000	$1,162,642	Development ... 1,197,331	1913	..	...
	Vein		$5	$3.88	Depreciation 422,890	1914	..	...
						1915	6	6.82
Miami	Arizona	$3,735,570	747,114	$7,250,128	Depletion 12,509,689	1913	33	10.61
	Massive		$5	$9.71	Depreciation 1,861,857	1914	33	9.20
						1915	42	8.77
Mohawk	Michigan	$2,500,000	100,000	$2,113,191	Depletion 3,139,935	1913	6	10.42
	Lode		$25	$21.13	Depreciation 1,475,461	1914	11	8.23
						1915	16	7.48
Nevada Con.	Nevada	$9,997,285	1,999,457	$8,703,049	Depletion 3,521,014	1913	65	...
	Massive		$5	$4.33	Depreciation. ... 7,159,907	1914	49	9.82
						1915	63	8.23
New Cornelia	Arizona	$9,000,000	1,800,000	$4,718,529	Depletion 3,210,860	1913	..	...
	Massive		$5	$2.62	Depreciation 2,419,376	1914	..	...
						1915	..	...
North Butte	Montana	$6,450,000	430,000	$1,309,525	Depletion 2,938,233	1913	28	9.76
	Vein		$15	$3.05		1914	18	11.50
						1915	19	13.12
Old Dominion	Arizona	$7,426,775	297,071	$665,125	Depletion 3,795,837	1913	31	9.70
	Vein		$25	$2.24	Depreciation 3,454,034	1914	30	8.22
						1915	28	8.90
Phelps Dodge	Arizona	$45,000,000	450,000	$13,490,156	Depletion 58,384,895	1913	156	...
	Vein and massive		$100	$29.98	Depreciation 7,342,547	1914	132	...
						1915	140	...
Quincy	Michigan	$2,750,000	110,000	$1,879,265	Depletion 2,158,688	1913	12	13.65
	Lode		$25	$17.08	Depreciation 1,547,240	1914	15	11.51
						1915	22	9.42
Ray Con.	Arizona	$15,771,790	1,577,179	$9,263,953	Depletion 968,535	1913	52	9.78
	Massive		$10	$5.78	Depreciation 2,903,725	1914	57	8.84
					Development ... 6,057,503	1915	60	9.49
U. V. X.	Arizona	$525,000	1,050,000	$9,524,165	Taxes, insurance,	1913	..	...
	Vein		50c.	$9.07	and interest .. 12,252,910	1914	..	...
					Depreciation 5,264,747	1915	..	...
Utah Copper	Utah	$16,244,900	1,624,490	$21,108,147	Depletion 12,738,035	1913	114	9.50
	Massive		$10	$12.99	Depreciation 1,710,423	1914	116	8.13
					Development ... 610,339	1915	148	7.56

(a) The following companies' reserves represent the accumulation of several years and the totals herewith do not appear in the balance-sheet of the company as customary in other companies: Ahmeek, Calumet & Hecla, East Butte, Kennecott, and Miami.

(b) Costs are intended to include taxes but not depreciation and depletion. Credits for gold and silver are allowed. There may be some lack of uniformity as between different companies with respect to depreciation and taxes. Changes in methods of accounting and the wide variation in the amount of Federal income taxes tend to make the net costs erratic during the three later years.

(c) $25,000,000 notes, 6%; and $25,000,000 notes, 7%; due January 1929.

(d) Where two figures are given, the one beneath shows the copper content of the ore as mined.

(e) Does not include 1,229,741 shares of New Cornelia.

MINING ENTERPRISES IN NORTH AND SOUTH AMERICA

Production in millions of pounds and net cost in cents per pound: Year	Millions	Cents	Ore mined during 1920: Tonnage	Pounds copper recovered per ton of ore (d)	Estimated ore resources or ore reserves as of January 1, 1921: Tons	Pounds copper per ton of ore	Dividend: Year	Per share	Gross, to July 15, 1921	Range of prices of stock for three years, 1913 to 1915: High	Low	Range of prices of stock for four years, 1918 to 1921: High	Low	High price of stock during first week of January 1922
1918 1919 1920	25 17 20	14.30 12.60 11.80	822,192	25			1918 1919 1920	10.00 3.00 1.50	12,150,000	300	92½	91	40	63
1918 1919 1920	272 130 139	17.00 14.50 16.50	1,828,379 (i)	75.9	55,000,000 (m)	66.0	1918 1919 1920	$8.00 4.50 3.00	$360,128,966	91⅝	30⅞	77⅞	31⅜	48⅝
1918 1919 1920	77 44 65	16.25 . . . 15.70(o)	2,205,200	29 41.5	264,390,000	43.2	1918 1919 1920	. . . .	. . . .	18	4½	. . . .	. . . .	(h)
1918 1919 1920	51 45 42	16.00 13.00 14.00	493,672	88			1918 1919 1920	8.00 3.00 4.00	46,272,949	78¾	51½	86¼	39¾	59
1918 1919 1920	68 53 58(g)	21.55 16.06 15.34(p)	1,560,240	28			1918 1919 1920	55.00 10.00 5.00	152,250,000	630	350	480	200	270
1918 1919 1920	72 58 53	10.00 14.00 11.90					1918 1919 1920	5.00 4.00 4.00	19,581,761	55	34	67½	23	33½
1918 1919 1920	102 77 11	13.30 13.01 10.70	4,243,301	26.3 30.8	690,306,106	42.4	1918 1919 1920	. . . .	. . . .	26⅝	23⅝	29¼	7¾	15¼
1918 1919 1920	76 40 44	14.02 15.31 14.46(l)	1,838,140	24.9 35.2	103,811,623	30.6	1918 1919 1920	4.50 3.00 1.12½	29,991,709	57⅜	30⅝	50⅞	16⅝	36⅝
1918 1919 1920	27 23 17	14.46 15.02 13.90	452,957	38			1918 1919 1920	6.00 2.50 1.50	26,998,345	64¼	35½	62	25	38¼
1918 1919 1920	25 20 19	19.71 15.58 15.85(n)	199,514	53			1918 1919 1920	1.50 0.50 0.50	1,673,752	. . . .	. . . .	20⅞	7	11
1918 1919 1920	43 28 26	19.80 21.00 15.94	749,090	34	21,000,000(r)	35.0	1918 1919 1920	10.00 3.75 . . .	10,029,387	91	51	86	15	28½
1918 1919 1920	53 41 44	15.08 14.75 16.30(q)	1,053,806	43			1918 1919 1920	8.00 1.50 1.00	32,641,565	52⅝	27⅝	58¼	15	27¼
1918 1919 1920	18 17 18	9.20 9.10 9.60(n)	710,450	25	6,638,666(r)	44.0	1918 1919 1920	. . . . . . 0.20	1,289,697	7¾	2½	5⅞	1⅞	2½
1918 1919 1920	99 78 79	11.26 13.41 14.17(l)	5,100,572	15.6 22.7	77,477,123	32.0	1918 1919 1920	8.00 6.00 3.50	41,938,617	47½	13⅞	69¾	28	38½
1918 1919 1920	61 71 52	9.20 9.60 10.84	674,472	77			1918 1919 1920	4.00 2.00 2.00	54,816,036	59¼	25	43⅛	14⅝	25¾
1918 1919 1920	11 10 9	16.42 14.52 18.29	100,872	87	827,000(r)	100	1918 1919 1920	1.50 0.50 . . .	1,704,000	16	12¼	52	15⅝	28¼
1918 1919 1920	58 54 56	14.83 15.81 11.90	1,801,958	30.8 39.3	52,723,410	31.0	1918 1919 1920	4.50 2.50 2.00	23,407,057	36⅛	17¼	33⅛	14⅛	27⅛
1918 1919 1920	11 13 10	14.64 13.98 13.70	434,988	24			1918 1919 1920	10.00 5.00 5.50	9,675,000	98	43½	83	41½	55
1918 1919 1920	77 44 48	15.69 16.14 17.28(l)	2,568,588	20.3 29.0	63,845,631	31.6	1918 1919 1920	3.25 1.50 0.75	46,786,617	20	10¼	21⅞	8	14¾
1918 1919 1920	47 40 40	13.30 13.20 13.00	1,727,859	23	50,000,000	31.6	1918 1919 1920	0.25 . . . 0.50	1,350,000	. . . .	. . . .	29¼	12	17¾
1918 1919 1920	21 14 17	20.91 14.85 17.64(l)	312,982	53			1918 1919 1920	1.00	14,656,500	38⅞	19¾	20⅝	8	12¾
1918 1919 1920	33 28 23	20.60 17.50 20.20	249,111	92			1918 1919 1920	4.00	14,405,260	64	38½	52½	15	23½
1918 1919 1920	169 104 96	16.00 15.00 17.00	1,565,547	61			1918 1919 1920	22.00 15.50 10.00	98,096,537	260	195½	280	155	. . . .
1918 1919 1920	20 19 19	20.15 17.54 17.70	809,263	23			1918 1919 1920	8.50 4.00 1.00	27,002,500	95	50	83	33½	43¼
1918 1919 1920	84 46 47	17.19 14.94 15.56	1,706,928	28.2 34.4	83,004,043	41.36	1918 1919 1920	3.25 2.00 1.00	25,412,620	27½	15	27½	10	14⅝
1918 1919 1920	55 29 42	9.00 9.80 8.53(n)	161,617	259	1,148,800(r)	236	1918 1919 1920	4.50 2.25 2.00	12,442,500	6½	⅝	52	18	29¼
1918 1919 1920	188 105 102	14.53 12.37 13.14(l)	5,556,800 (k)	18.8 23.2	364,130,800	27.0	1918 1919 1920	10.00 6.00 6.00	113,946,398	81¾	39⅝	97½	41⅞	61⅞

(f) Calumet & Hecla; not including shares in subsidiaries.

(g) Includes copper from old tailing in Torch lake. Total, including subsidiaries, 101,498,789 lb. in 1920.

(h) No quotation because of ownership by Kennecott.

(i) $15,000,000 convertible 10-year 7% bonds, and $35,000,000 convertible 15-year 6% bonds.

(j) Anaconda also produced in 1920, 101,332,000 lb. of zinc, 6,420,000 oz. of silver, and 32,530 oz. of gold.

(k) United Verde Extension also produced in 1920, 359,370 oz. of silver and 5530 oz. of gold.

(l) Includes depreciation but not depletion.

(m) Estimated according to the prediction of J. F. Kemp.

(n) Cost reduced materially by credits for silver.

(o) Direct operating cost, 13 cents.

(p) Cost includes production from Torch lake at 6.60c. per pound.

(q) Includes Mexican taxes.

(r) Estimated.

general considerations that have a bearing on the problem.

DATA REGARDING SUNDRY COMPANIES

The accompanying table gives data concerning 27 of the leading copper-producing companies that paid dividends as late as 1918. The figures were obtained principally from three sources; namely, the small book published by Hayden, Stone & Co., of Boston, called 'Mining Companies'; Walter Harvey Weed's 'Mines Handbook'; and a compilation prepared by Cameron, Michel & Co., of New York. The information is believed to be accurate, as those who prepared the publications mentioned obtained it from presumably reliable sources. It is apparent that the companies are well-established concerns that have produced copper at a profit—there is no question of fake promotion. It may be assumed also that the financial management is trustworthy and capable; likewise that the honesty and competence of the engineers who direct the technical work of all of the enterprises is unquestioned, though, no doubt, some are more able than others. One remaining element of uncertainty is the way Nature has dispensed her favors, and even in this particular the uncertainty is far less than it was in all mining undertakings 20 years ago and much less than in most of the enterprises producing gold and silver, and even lead and zinc, ores today.

MASSIVE OR BLANKET DEPOSITS

This is a consequence of the exploitation during recent years of huge 'massive' or 'blanket' deposits of low-grade ore of which the so-called porphyry coppers are typical. By means of modern methods of sampling with churn-drills it is possible to foretell with confidence the results to be obtained from mining these massive ore-bodies. The tonnage and grade of the ore in the entire deposit can be determined accurately; this is indicated by the data in the table, where the estimates of ore-reserves for the 'porphyry' mines only, can be regarded as even approaching the quantity that probably will be mined. At Butte, for instance, it would be impracticable, obviously, to develop the hundreds of veins that traverse the Anaconda property so as to disclose the ore-shoots far in advance of stoping. In heavy ground the cost of keeping open the drifts and cross-cuts would be prohibitive; and yet no well-informed engineer questions the immensity of the copper production still to be made by the Anaconda company from the mines at Butte, by the lode-mining companies of Michigan and of Arizona, and by companies elsewhere that are similarly circumstanced.

Incidentally, it is interesting to note that many of the largest vein-mining companies have interests in enterprises where the ore-deposit is of the massive type. The Phelps Dodge Corporation is to annihilate Sacramento hill at Bisbee and will mill most of the resulting material; the Calumet & Arizona company owns more than two-thirds of the stock of the New Cornelia company; the Kennecott Copper Corporation owns three-eighths of the stock of the Utah Copper Co. and virtually all that of the Braden company; and the Anaconda Copper company owns a third of the Inspiration stock and holds as a subsidiary the Andes Copper Co., owner of a mine in Chile, where 128,000,000 tons of 1.49% copper ore is already assured by drilling. Two significant facts may be mentioned: first, that the number of partly developed high-grade copper mines that are available for exploitation is becoming constantly smaller; second, that economical methods of mining and of treating ore have made it possible to win a profit from low-grade material that a few years ago was considered to be valueless. It is a fair assumption that most of the important copper mines of the future will derive their ore from deposits of the massive type and that accordingly it will be possible to ascertain with comparative accuracy the quantity and copper content of their ore.

ORE-RERVES OR ORE-RESOURCES

It is evident that one of the fundamental factors upon which an intelligent appraisal of the value of any mine, and therefore of any mining stock, depends is the ore-reserve; or, to put it another way, the 'ore-resources' of the mine. The word 'reserve' is applied properly to ore that has been at least partly blocked out and measured. 'Ore-resources', on the other hand, may be interpreted as having a broader meaning; it may refer to potential ore, the existence of which seems assured because of geologic conditions and experience in neighboring areas. In Michigan the productive life of some of the copper mines is estimated at 10, that of others at 30, years, under the normal scale of operation. This estimate is not based on the quantity of ore blocked out, but on a comparison with the experience in other mines near-by. As pointed out before, the actual ore-reserve of the Anaconda company at Butte is small as compared with its ore-resources. James F. Kemp, after a recent examination of the property in behalf of the American Brass company, has estimated the "indicated reserves" as being sufficient to supply 3.3% ore for the normal requirements of the reduction plants for 15 years. If future operations of the company had to depend upon the present supply of proved or partly proved ore the shares would be far less valuable than they are actually.

Only a few companies other than the so-called porphyries publish estimates of their ore-reserve, for the reason that the figures might mislead those who did not appreciate this distinction between reserve and resources. Nevertheless the task of making any reliable computation of the value of the shares of any mining company cannot even be commenced without knowing approximately, or at least assuming, the quantity and grade of the ore that eventually will be mined. In the table where figures are shown without comment or foot-note the ore-reserves are given as reported to the public by the companies themselves. The other data in this column are explained in each instance.

CALCULATION OF THE PRESENT OR ACTUARIAL VALUE

The mathematical calculation of the 'present' or 'actuarial' value of mining shares based on known or estimated figures may be illustrated by the solution of a hypothetical problem. The following data may be assumed:

Number of shares (no par value)	500,000
Annual capacity of plant, tons	2,500,000
Ore reserve, tons	25,000,000
Recoverable copper per ton ore, pounds	30
Cost of producing copper, cents per pound	12
Selling price for copper, cents per pound	15
Excess of current assets over current liabilities	$5,000,000

The life of the mine would be 10 years, and the annual operating profit would be $3,750,000 or $7.50 per share. The present value of $7.50 per year for 10 years on an assumed basis of 9% income would be $43.27, this being obtained by multiplying by 7.5 the figure $5.77, found in Table II under '10 years' and '9%'. The table is based on $1. Of the $7.50, $3.89 would represent interest at 9% on $43.27; while if $3.61 were re-invested annually at 4% compound interest it would amount to $43.27. In other words, a sinking fund would be created to amortize the original investment. In addition account must be taken of the $5,000,000 operating capital represented by the excess of current assets over current liabilities, which presumably would remain nearly constant until the end of the period of operations and would then be available for distribution among the shareholders. From Table III we find that the present value of $10 (the quotient of $5,000,000 divided among 500,000 shares) discounted at 8%, is $4.63. Theoretically one of the hypothetical shares would be worth $47.90—although the dividends to be received would amount to $75 plus $10, or $85 per share.

The value of plant and equipment at the time of the exhaustion of the mine would depend on local conditions; usually it would be comparatively small. There would also be the chance of material increase in the ore-reserves as the result of future development, but this might well be regarded merely as a factor of safety. Income from dividend-paying investments in the shares of other mining companies, as in the instance of the Utah Copper Co., which owns a controlling stock-interest in the Nevada Consolidated, would enhance the value of the shares of the holding company; on the other hand, funded indebtedness in the form of outstanding bonds would have the opposite effect. If adequate information were available upon which to base judgment as to the reasonably assured dividends from such investments, a separate calculation of the present value of them could be made and added to the figure already obtained; or the amount of the income could be added directly to the operating profit in the original computation. On the other hand, the earnings should be diminished by an amount sufficient to pay interest and to create a sinking fund for the redemption of outstanding bonds at maturity. The existence of such features obviously would complicate the calculation slightly; but, after making the necessary allowances, a computation similar to the one shown should give the approximate value of the shares at the date of the supposed purchase.

The whole appraisal is based of course on the assumption that the mine is to be in steady operation at normal capacity. A person of a pessimistic turn might be inclined, not without justification, to point to the past two years and argue that the assumption of steady operation is unwarranted. However, many excellent arguments are advanced by students of the industry that convince them that a repetition of any such depression is extremely unlikely. Many of the facts upon which these arguments are based will appear in the course of this article.

TABLE II

Present Value of an Annual Dividend of $1, for 'a' Years at 'b' %, Assuming Capital to be Replaced by Reinvestments at 4%

Years	7%	8%	9%	10%
6	$4.53	$4.33	$4.15	$3.90
7	5.09	4 84	4 62	4 41
8	5.60	5.30	5.04	4.79
9	6.08	5.73	5.42	5.14
10	6.52	6.12	5.77	5.45
11	6.94	6.49	6.09	5.74
12	7.32	6.82	6 39	6.00
13	7.68	7.13	6.66	6.24
14	8.02	7.42	6.91	6.46
15	8.34	7.79	7.14	6.67
16	8.63	7.95	7.36	6.86
17	8.91	8.18	7.56	7.03
18	9.17	8.40	7.75	7.19
19	9.42	8.61	7.93	7.34
20	9.65	8.80	8.09	7.49
21	9.87	8.99	8.24	7.62
22	10.08	9.16	8.39	7.74
23	10.28	9.32	8.52	7.85
24	10.46	9.47	8.65	7.96
25	10.64	9.61	8.77	8.06
26	10.80	9.75	8.88	8.16
27	10.96	9.88	8.99	8.25
28	11.11	10.00	9.09	8.33
29	11.25	10.11	9.18	8.41
30	11.38	10.22	9.27	8.49

Should there be no definite information as to plans for increasing the capacity of reduction plants, the rate of future production would be estimated by considering the past record. In general, the tonnage treated in 1916 and 1917 is probably higher than the economical maximum. In order to swell production during the period of high prices, operations were expanded to an extent such that efficient work could not be done. Likewise the estimate of the cost of future production would have to be based on past performances; the figures would be modified accord-

TABLE III

Present Value of $1 Payable in 'a' Years With Discount Compounded at 'b' %

Years	7%	8%	9%	10%
6	$0.666	$0.630	$0.596	$0.564
7	0.623	0.583	0.547	0.513
8	0.582	0.540	0.502	0.467
9	0.544	0.500	0.460	0.424
10	0.508	0.463	0.422	0.386
11	0.475	0.429	0.388	0.350
12	0.444	0.397	0.356	0.319
13	0.415	0.368	0.326	0.290
14	0.388	0.340	0.299	0.263
15	0.362	0.315	0.275	0.239
16	0.339	0.292	0.252	0.218
17	0.316	0.270	0.231	0.198
18	0.296	0.250	0.212	0.180
19	0.276	0.232	0.194	0.164
20	0.258	0.215	0.178	0.149
21	0.241	0.199	0.164	0.135
22	0.266	0.184	0.150	0.123
23	0.211	0.170	0.138	0.112
24	0.197	0.158	0.126	0.102
25	0.184	0.146	0.116	0.092
26	0.172	0.135	0.106	0.084
27	0.161	0.125	0.098	0.076
28	0.150	0.116	0.090	0.069
29	0.140	0.107	0.082	0.063
30	0.131	0.099	0.075	0.057

ing to the judgment of the prospective investor or his advisers, after a careful analysis of sundry variable factors of which the first five, enumerated below, are the more important. The last item in the list—the selling price of the product—taken in conjunction with the cost of production would determine another all-important factor in the calculation of the share-value, namely, the per-ton profit on the ore. The remainder of this article will consist of a brief discussion of the following subjects as related to the future of the copper-mining industry.

(1) Metallurgic efficiency
(2) Cost of labor
(3) Cost of supplies for mining and reduction
(4) Cost of power
(5) Freight on product marketed
(6) Market price for copper.

Although the last is by long odds the most important, the others need to be considered carefully. It is not impossible that unforeseen changes in the character of ore in specific instances might result in a decreased recovery of copper, but this is improbable. On the other hand, every reason exists to anticipate improved metallurgic efficiency, particularly in concentration as distinguished from smelting.

Improvements in Metallurgy

No one conversant with the progress made in concentration doubts that a complete recovery will be approached more nearly than it has been, in spite of the strides made in the last decade. The period of suspension of operations in the copper industry has been devoted to research and experiment in an intensive way, and I do not hesitate to predict that the recovery attained at many plants when milling is resumed will exceed the best records made in the same plants before the shut-down. At one large concentrator a saving of $200,000 per year will be accomplished merely by a change in flotation reagents, and this will be acompanied by improved recovery in the concentrate. Advantage has been taken of the shut-down to remodel and alter plants with a view to lessening the cost of operation. An interesting record that emphasizes improvement in concentration is the performance during 1920 of the Calumet & Hecla company, whereby 14,138,240 lb. of copper was recovered from old tailing having an average content of 13.10 lb. per ton. Of this, 10.24 lb., or practically 80% of the total, was recovered, at a cost of 6.6c. per pound. It is estimated that the cost will be reduced to 4½ or 5c. per pound when the prices paid for labor, coal, and other supplies shall have been readjusted to 'normal'. Calculations show that there is about 35,000,000 tons of tailing still to be treated with an estimated gross copper content of 400,000,000 pounds.

Recent improvements and refinements in the technique of leaching low-grade copper ore have been notable, and a decided increase in the quantity of ore subjected to this treatment may be anticipated. In Arizona, for example, both the Miami and Inspiration companies have large reserves of oxidized and mixed ores from which they have not attempted as yet to recover the copper. One great advantage of leaching is that the costly smelting process is made unnecessary, because refined copper is precipitated from the leach-solution by electrolysis. It is said that the Inspiration company has already decided to erect a leaching plant essentially like that of the New Cornelia company at Ajo. In making a calculation of the value of the shares of any particular company the only safe criterion by which to estimate future metallurgical performance is the past record. Each enterprise is a problem in itself, but, speaking generally, it is safe to anticipate some improvement in metallurgic results and a consequent favorable influence on the factor of 'profit per ton of ore'.

Wages and Future Labor-Costs

It would be hazardous to perdict that wages ever will return to pre-war levels. Nevertheless the wages of miners, and mill- and smelter-men, and other employees in the industry have already been reduced by from 20 to 30%; and from every hand come reports of greatly increased individual efficiency on the part of workmen. This last condition invariably accompanies restriction or curtailment of industry, for in spite of schemes to alter arbitrarily the law of supply and demand, wages are low and personal efficiency is high when jobs are scarce. Continued decrease in the cost of living may warrant further reduction in wages; and, on the other hand, a resumption of industrial activity throughout the country conceivably may have the effect of lessening the number of idle men to an extent such that a man need not work so hard to keep his place on the payroll; but there is little likelihood of a return to conditions as they existed during the War, when miners and other laborers did about as they pleased and were paid wages far in excess of what they had even dreamed a few years before. Frequently some contract system that would net the miner as much as from $8 to $12 per day in the so-called high-priced districts was the only method of payment that obtained any results whatever. This was true at Butte, where the nominal wage-scale was $5.75 per shift. This has now been cut to $4.25, as compared with $3.50 before the War. A reasonable conclusion seems to be that the labor-cost of producing copper during the next 15 years will be somewhere between that of 1918 and that of 1913, probably nearer the latter than the former.

In this connection mention may be made of the improved equipment for underground work, the result of which will be to reduce the labor-cost by the substitution of mechanical energy for human effort. Methods of mining are not susceptible of radical improvements comparable with those made in metallurgy, but there is much room for increased efficiency in accomplishing the various fundamental operations. The work comprehended by the term 'mucking', meaning the moving of ore from the place where it is broken to a car or a chute, was done by hand almost invariably before 1914. It is tedious labor, wasteful of human effort. One good result of the war period was the added emphasis given to the need for improving upon this primitive method of handling rock. When it was impossible to get men to work at any price, attention was turned to the devising of small mechanical shoveling machines and mechanically operated scrapers. The impetus given to the development of these devices has been such that 'mucking' of the old-fashioned kind soon may become obsolete. The 'No. 2' shovel will doubtless retain a place underground, but, except in small prospects, the bulk of the ore will be loaded by mechanical means. At some mines the utilization of mechanical equipment, in conjunction with lower wages and increased personal efficiency, will result in a labor-cost for mining even lower than that prevailing in 1914.

DECLINE IN THE COST OF SUPPLIES AND MATERIALS

The cost of supplies for the mining and treatment of ore has already decreased measurably since 1920, and every indication points to still further reductions. In the 'Mining and Scientific Press' of September 17, 1921, a comparison was made of the price of certain supplies and materials in August 1920 and in August 1921. Except for two items, the decrease ranged from 10 to 50% and averaged about 20%. The tendency is still downward; how far the reduction will go is uncertain but there is no reason, at the present time, to anticipate a reaction in the opposite direction, and the further decrease may be appreciable.

COST OF POWER

Another important item is the cost of power. In Michigan, where coal is used to generate steam for power purposes, the variation in the price of fuel has a material bearing on the net cost of production. In Arizona, New Mexico, and northern Mexico expensive oil is burned in Diesel engines that serve as prime movers in the electric power-plants. The price of coal in Michigan, the greater part of which arises from freight-charges, should be less than it was during 1919 and 1920, thereby effecting a lower cost for steam-power; and, in the South-West, the development of hydro-electric energy from the Colorado river is being relied upon to supply power at reasonable cost. It is uncertain as yet how soon any considerable portion of the truly tremendous potential energy now dissipated in the Grand Canyon will be made available for industrial use. In the meantime, the price of fuel-oil is likely to increase rather than to decrease; for this reason, among others, the mine-owners are particularly anxious to hasten the harnessing of the Colorado. According to L. D. Ricketts, the mines and smelters of the South-West now require about 70,000 hp. in addition to power generated from 'waste' heat and this demand will be increased to 100,000 hp. within four or five years. Taking the American copper-mining industry as a whole the conclusion is probably justified that the unit cost of power should be less during the next fifteen years than it has been for the last five, and probably less than for the last twenty.

FREIGHT-RATES PLAY AN IMPORTANT PART

Speaking generally, copper is not found near the point of consumption. This means that the cost of transportation of bullion, especially in the Western States, is a large item in the expense of marketing, and, therefore, an important factor in the determination of the profit per ton of ore. If any corroboration of this were needed it might be found in a recent statement by James S. Douglas, president of the United Verde Extension company. He assigns to high freight-rates on copper bullion one of the first places among the obstacles to reasonably profitable operations at Jerome. Solution of this problem for the producers in Arizona and in the South-West generally may be the establishment of railroad connections between the smelters and the Gulf of California so that copper may be shipped to New York by boat through the Panama Canal. Surveys for such a railway have been made; and in the meantime effort is being made to obtain a satisfactory rate on rail-shipments to Los Angeles. A 3000-mile haul by rail to the Atlantic seaboard as compared with 300 miles to the Pacific Coast followed by an inexpensive shipment for 6000 miles by sea, seems to be an economic waste. Factors, however, that should not be overlooked are the cost of trans-shipment and of marine insurance, and the time consumed. The last need not be considered when blister copper is stored everywhere as at present, but it does have an influence in normal times.

Besides the part played by freight-rates in the hauling of the product to market, must be considered the effect of the high cost of transportation on bulky supplies and commodities essential to carrying on the industry. Freight-rates have been reduced already in many places and the railroads have indicated their intention to make further reductions, irrespective of any action by the Interstate Commerce Commission. The roads naturally must look out for themselves, but they will make the required reductions if convinced that they are necessary to revive and preserve the mining industry.

It is apparent that the trend of each of the chief factors involved in the cost of producing copper is downward. Economic forces are so complex and so uncertain as to make it impossible to predict with any assurance how far this downward trend will go ultimately. Although they do not even hope to see another period of cheap production like that of 1910, 1911, and 1912, the engineers in charge of the older enterprises look forward confidently to being able, by virtue of efficient methods in every department, to approach closely the record of low costs established in those years. As to the newer enterprises, like Braden and Chile Copper, new low records will doubtless be made.

THE EFFECT OF THE SURPLUS STOCK ON THE PRICE FOR COPPER

But, no matter how economical and efficient operations may be, nor how cheaply copper can be made, there must be a market at a price in excess of the cost of production by any particular company, if that company is to continue to operate. The price of copper theoretically is subject to the law of supply and demand; practically, it has been controlled to a certain extent by concerted action on the part of strong producers in curtailing output when the stock of finished metal in the market has been excessive. That condition confronted the producers early in 1921; a surplus of more than a billion pounds existed, and production exceeded current consumption. If the law of supply and demand had been allowed to take its course at the beginning of the year, the various companies, theoretically, would have been forced to suspend production successively in the order of their cost of making and marketing the metal, beginning of course with the highest-cost producer. At first the surplus stock would have continued to increase, the market quotations for copper would have decreased, and other companies would have shut-down until only the few that were able to produce at the least cost would have survived. For a time there would have existed a condition of approximate equilibrium. Then the stock of metal would have decreased gradually, the market price would have increased; one at a time the companies would have resumed, but in the opposite order from their shutting-down. This hypothetical chain of events might be elaborated by including the fluctuations in consumption of the metal. If economic laws functioned as precisely and promptly as the laws of nature the consumption of metal would have been stimulated as the price gradually lowered and the depletion of the excess stock would have been accelerated. On the other hand, the subsequent increase in price would have discouraged use of the metal and would have tended to retard the resumption of mining operations.

If the processes of shutting-down a mine, mill, and smelter, and of re-organizing a force of men and re-starting the plants were as simple, for instance, as the switching on and off of an electric light, and if expenditures stopped with shutting-down as the current does when the switch is off, the suspension of production last spring by tacit agreement might, possibly, never have occurred; the companies might have concluded individually to let the devil take the hindmost. Or, more likely, production might have been suspended entirely for a time by all of the companies, including New Cornelia, Chile, Quincy, Miami, Copper Range, Cerro de Pasco, Kennecott, Mohawk, and the few others that are still producing on a large though curtailed scale. It was evident that eventually a shut-down of some mines was unavoidable; the Jackling, Anaconda, Calumet & Hecla, Phelps Dodge, and other interests concluded that the industry, and consequently they themselves, would gain if the large companies suspended production voluntarily and in concert, instead of allowing Nature's law of the survival of the fittest to determine the order and extent of shutting-down; this process of elimination would have strained the resources of the survivors seriously and, moreover, would have deferred the reduction of the surplus stock of metal to reasonable size. Some of the mines that were shut-down in all probability could have continued production at an operating loss that was less than the 'shut-down' expense actually has been; but the results of the suspension have proved the soundness of the reasoning that dictated it. The Anaconda company has resumed production on a small scale; the United Verde and United Verde Extension have definitely announced resumption within a month and April 1 has been set as the date for commencement at several of the Calumet & Hecla mines in Michigan; other announcements may be made before this is printed. The fact should be emphasized, however, that caution will be the watchword.

Diminution of the Surplus Stock

Reverting to the consideration of the probable selling price for copper during the next fifteen years, there may be enumerated a number of pertinent facts that support the view that the demand for the metal will be excellent and the price reasonably high. In the first place the surplus of unsold metal has been decreased by nearly 300,000,000 lb. during the last year and is, at the present time, being further decreased at the rate of fully 50,000,000 lb. per month, this figure representing the excess of current consumption over current production. It is estimated that the normal supply of unsold copper should be around 350,000,000 lb. and that the actual present supply is 700,000,000 lb. This would leave 350,000,000 lb. to be used, over and above the current production of 40,000,000 lb. per month from North and South America, before the surplus would disappear. At the rate of 50,000,000 lb. per month, seven months would be required, but the fact must be borne in mind that from three to four months elapses from the time ore is taken from the mine until the copper it contains is ready for the market. On this basis it would seem logical to commence production at a rate not greater than the current consumption soon after April 1, 1922; which, in fact, is the date mentioned in most rumors of resumption.

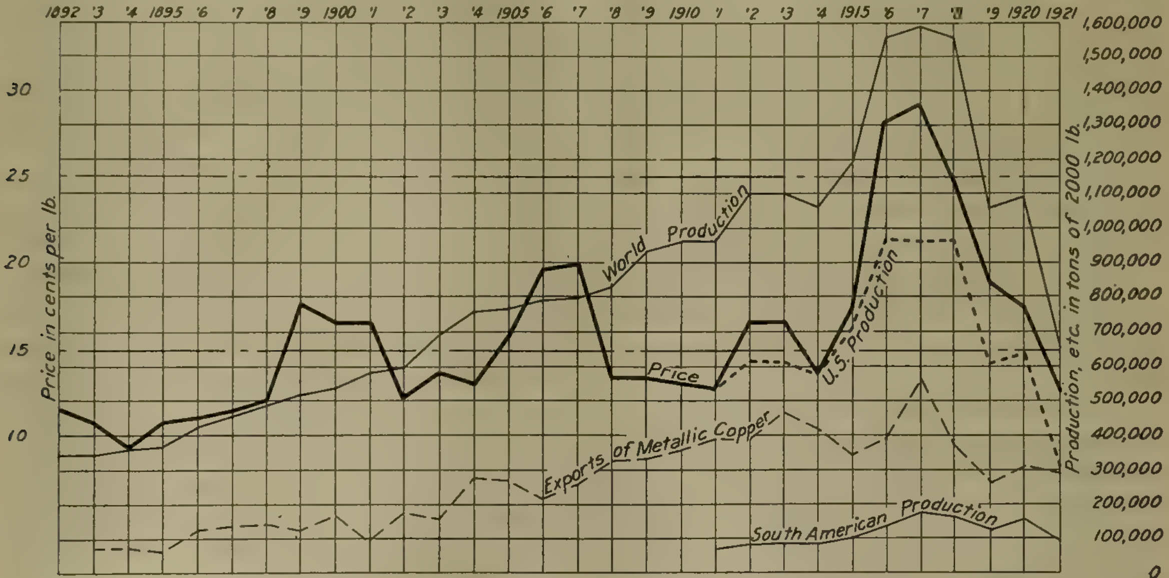
Necessity for Caution

Should all the mines that are idle or at which production is materially curtailed commence to operate at full capacity this spring the output would be in excess of consumption and the surplus would again commence to accumulate. It is the recognition of such a possibility that impels the exercise of extreme caution in ordering a resumption of production. The companies are in the position of a small boy who has just been burnt; while the memory of it is fresh he won't play with fire. They dread a surplus. The accompanying curve, indicating graphically the fluctuation in output during the last 30 years, shows an abnormal production during 1917-'18-'19, the reasons for which need no repetition. The production in 1919 and 1920, however, is not in excess of what should have been expected had normal economic forces been operative. In 1921 production was far below normal. The producers make the point that *under-consumption*—not over-production—since the War, allowed the surplus to increase during 1919 and 1920. This emphasizes the last important element in a summary of conditions in the copper-mining industry, namely, the need for stimulating the consumption of the metal.

Prospects for Increased Consumption

It is for this purpose primarily that the Copper & Brass Research Association has undertaken to re-establish the vogue of copper for the uses in which it was pre-eminent before the War and to develop new uses for the metal. One of the important functions of the association is to acquaint the public with the merits of articles and materials made of copper and brass. Like the politicians and the moving-picture directors, the manufacturers have their ears to the ground and give the people what they want; if they want copper and brass instead of wood or iron or glass or some other substitute, they get it; and, because, for a great many uses, copper is unquestionably superior and more economical in the long run, the organized effort to educate the public should be effective.

There is one potent force for increased consumption that is sometimes disregarded—that is, a reasonably low price for the metal. There will be purchasers for copper at 15c. who would not purchase at 17c.; and the need at the present time is to encourage buyers and to stimulate consumption. The industry in the end will be far better off if copper remains around 15c., for several years at least, than it would be if the price were to be manipulated to 20c.—a fact that no one appreciates better than the producers themselves. Viewed from another angle, high prices for copper would tempt mining at a rate greater than consumption warrants and the result would be the accumulation of another surplus. Efficient and economical operation, and a small margin of profit on production at the full capacity of his property seem to offer most to the copper miner today. Manifestly, one of the essentials to efficient production is operation at maximum capacity.



GRAPHS SHOWING RECENT STATISTICS OF COPPER PRODUCTION AND PRICE

High Price Restricts Use of the Metal

In connection with the question of prices, attention should be drawn to the disadvantage under which copper has labored because of an apparent disinclination on the part of fabricators of copper and brass to sell, at a sacrifice if need be, stock manufactured from high-priced copper, and perhaps at a high labor-cost. Either this policy on their part or wasteful methods of manufacture or of distribution, or a combination of these, resulted in an unjustified spread between the cost of refined copper and of the manufactured products. Whatever the reasons may have been, there is no denying the fact, nor the result, namely, a tendency to restrict the consumption of copper. The intention to obviate this bad condition is one of the Anaconda company's reasons for negotiating the purchase of a controlling interest in the American Brass Co. Clearly it is to Anaconda's advantage to stimulate the market for brass because that will stimulate the production of metals, wherein lies Anaconda's greatest profit. This will be accomplished most effectively by selling manufactured goods at a reasonable price. Manufacturing companies of a similar character will be obliged to improve their methods or cut their profits to compete with the American Brass Co., and general benefit to the copper-mining industry should ensue, although there should be no delusion as to Anaconda's motives being unselfish.

Other influences working toward greater consumption may be mentioned. The electrification of railroads, both old and new, and the really marvelous expansion in hydro-electric power development that is assured in the immediate future both indicate an important demand for copper. The resumption in building of both residential and of business and industrial structures is already under way and the requirements for copper will be large, partly as a direct result of the work done by the Copper & Brass Research Association.

One important outlet of American copper is Europe; how long it will be before the market there becomes normal no one can say. Certainly one of the first commodities that will be imported in quantity, when financial adjustments make increased business possible, is copper. The metal is vitally necessary and comparatively little of it is produced in Europe, so that further improvement in exchange and a semblance of prosperity should be accompanied by increased purchases. Germany has been the largest importer of American copper in recent months, in spite of the heavy handicap of demoralized exchange rates; 212,101,000 lb. has been taken by that country during the past year. Germany has always been one of America's best customers for copper and as soon as the time comes when she can supply her needs, she will take not only the regular amount but a large excess to renew the stocks that disappeared during the War.

A SHORTAGE OF COPPER POSSIBLE WITHIN 15 YEARS

J. Parke Channing, in a recent address at Columbia University, made this forecast regarding the future: "The 'porphyry' mines have been worked for very nearly fifteen years and at present are the main source of production in the United States. In the meantime there have been discoveries of some large deposits in South America and also in Central Africa, but, as a whole, I think we can safely say that the copper resources of the world are extremely limited, in fact they are more limited than those of any other of the baser metals, and unless new deposits are found we will be threatened in fifteen years with another shortage of copper".

In the meantime it seems reasonable to predict a healthily increasing domestic consumption and before long a satisfactory foreign consumption. This should assure a firm and moderately high market price, which is the sixth of the factors previously enumerated as being involved in the determination of the profit per ton to be realized by any copper-mining company, and in the appraisal of its shares.

SHARES ARE A LEGITIMATE INVESTMENT

To summarize, the value of a share in any copper-mining enterprise depends upon (*a*) the number of shares outstanding, (*b*) the future rate of production, (*c*) the 'ore resources', (*d*) the unit cost of production, and (*e*) the price obtained for the copper. If these factors were known with certainty (which they cannot be) the problem of calculating the value of the share would be one of arithmetic. Fluctuations in the price would depend upon the prevailing condition of the money market, just as do fluctuations in the quotations on Liberty bonds. With respect to the 'porphyry coppers', all but the last two factors are known with reasonable certainty; the fifth can be estimated more accurately than the last. I have endeavored to enumerate the more important economic influences that may affect these two. The question of weighing these influences is a matter of individual judgment, but any investor who makes an intelligent purchase of a copper-mining stock must perform just such an analysis as has been outlined. If he finds that a share in a particular company ought to be worth $30 and he can buy it for $20, he has a double opportunity for profit: first, the possibility of realizing by selling the share at an appreciated price; and, second, the reasonable certainty of receiving dividends sufficient to provide for the return of his investment with interest at whatever rate he has used in his appraisal. The fact in itself that this rate should be 9 or 10% makes it idle to deny that there are elements of uncertainty in mining that are absent in high-class railroads or public-utility securities, for example; but these copper shares have ceased to be the rash gambles of popular fancy and may be properly classed as legitimate investments.

THE production of precious metals in Oregon in 1921 is estimated by J. M. Hill, of the San Francisco office of the U. S. Geological Survey, to have been approximately 37,500 oz. gold, valued at $775,194; 43,120 oz. silver, 274,400 lb. copper, and 350 lb. lead. Although this represents a decrease of $242,296 in value of the gold, 48% in the quantity of silver, and 88% in the quantity of copper, as compared with 1920, mining in the State at the end of 1921 was far from being as depressed as these figures might indicate. The decrease was due largely to the curtailment of the operations of the Cornucopia and the Homestead Iron Dyke mines, in the eastern part of the State. The lessened activity at the Iron Dyke was due directly to the depression in the copper market. The dredges in Baker and Grant counties were active and made good returns. The U. S. Metals Co. developed a considerable quantity of silver-copper-lead ore at the Bay Horse mine, near Huntington, and expects to begin shipping from stock piles and from the mine in a short while. The Blue Mountain Mines Co., at Bourne, inceased its production. In south-western Oregon there was a decided midsummer revival of activity in the region tributary to Jackson and Gold Hill. The Old Sylvanite mine is being re-opened by the Oregon-Pittsburg Mining Co., and the Boswell mine, in the Holland district, by the Boswell Mining Co. The Opp mine, near Jackson, was re-opened in July, and the Millionaire, which has been under development for more than a year, has been milling steadily. In addition to these mines a number of others not so well known were under development, and since the middle of 1921 several of them have been making shipments.

BRAZILIAN mining industry received a great impetus through the war-time shortage of minerals, and in particular the mining of manganese ore was greatly developed, thanks to the American demand, states 'Schweiz. Chem.-Z'. Owing to the lack of fuel for smelting then experienced, an investigation was begun of the country's reserves in coal. Reports received from Belgium and England on coal from the Rio Grande do Sul and Santa Catharina mines state that 1 metric ton yielded 600 kilogrammes of good metallurgical coke with 18% ash, 59 kg. tar, 12 kg. benzol, 14 kg. ammonium sulphate, and 4750 cubic metres of gas. Attention has also been given to the utilization of hydro-electric power for metallurgical purposes, and it is evident that the Brazilian government is actively promoting the development of a domestic metallurgical, and especially of an iron, industry.

MOST of the vanadium deposits in Arizona contain wulfenite, according to an Arizona State Bureau of Mines bulletin. Vanadinite concentrate or ore is marketable if wulfenite content does not exceed 2 or 3%.

REVIEW OF MINING

PRODUCTION RESUMED BY COPPER QUEEN BRANCH OF THE PHELPS DODGE COMPANY AT DOUGLAS AND BISBEE

G. H. Dowell, general manager for the Copper Queen Branch of the Phelps Dodge company, announced on January 28 that the Copper Queen smelter at Douglas would be started on February 1, with three blast-furnaces going into operation, and 400 to 500 men being added to the payroll.

Three blast-furnaces will be fired up first at the smelter, and continue in service until such time as the brick stack at the plant is in readiness for service, then the ores will be smelted in the reverberatory furnaces, practically the only ones in action when the shut-down came last April.

Dowell stated also that within the next 30 days, or approximately March 1, the Bisbee district will begin to feel direct effects from the re-opening of the smelters at Douglas. On that date the Copper Queen mine will resume the actual production of copper ore. The present underground force may not even be increased to any particular extent at first—probably it will merely shift its activities from development work to actual ore production. The reason for this is that the ore-bins at Douglas are already over-stocked—there is enough ore on hand right now to last the smelter a long time. But, nevertheless, the Copper Queen mines will start getting out ore again about March 1.

POLICY OF THE GOVERNMENT WITH RESPECT TO FOREIGN OIL

In a letter to Representative Kissel of New York, which has been referred to the House Committee on Interstate Commerce, Ralph Arnold, consulting geologist and petroleum engineer of New York, advances three propositions with respect to the oil industry after a study of conditions in Mexico during the past ten years. They are: (1) That the United States must look to foreign countries for the gradually increasing proportion of its required oil, the United States now importing over 100,000,000 bbl. of crude oil annually. (2) That the United States must modify its laws or regulations to give its own nationals better treatment in operating on government lands before it can go to foreign countries and demand fair treatment. (3) That the Government must foster co-operation among the oil companies engaged in foreign work and if necessary make additional modifications of its laws, looking toward this end, if the present laws do not legally permit of the required co-operation.

COLORADO METAL MINING ASSOCIATION ELECTS OFFICERS

George A. Stahl of Denver, vice-president and general manager for the Vindicator Consolidated Gold Mining Co. of Cripple Creek, was chosen president of the Colorado Metal Mining Association for the coming year at a meeting of the newly-elected board of directors held at Denver on January 10. Other officers named by the board are: Jesse F. McDonald, Leadville, first vice-president; R. M. Anderson, Breckenridge, second vice-president; Bulkeley Wells, Denver, third vice-president; and M. B. Tomblin, Denver, secretary and treasurer. The convention held its sessions in the chamber of the house of representatives at the State house. Among those who read papers were: W. H. Leonard on 'Mechanical Muckers'; Dan A. Herrington, 'Ventilation of Metal Mines'; O. E. Anderson, 'Efficient Use of Explosives in Metal Mining'; John L. McMenamin, 'Co-Operative Purchase of Supplies'; Horace F. Lunt, State commissioner of mining, 'Merit Rating as Applied to Compensation Insurance'.

NEVADA CONSOLIDATED TO OPERATE AT 60% OF CAPACITY

Preliminary work has commenced at the smelter and concentrator of the Nevada Consolidated Copper Co., according to a dispatch from Ely. About 500 former employees of the company have arrived at Ely from Tonopah and other districts, and it is the general understanding that the mines and smelter are to be operated at 60% of normal capacity until the copper market justifies production on the pre-war scale. The company has men at work around its plant, and is gradually increasing the payroll. All copper held in storage has been marketed, and everything is in readiness at the mines for resumption of production.

CANADA SUSPENDS ORE-EXPORT REGULATIONS

The Canadian government has issued an order-in-council permitting the silver-lead ores of the Mayo district in the Yukon to be sent out of Canada for treatment for one year from December 1, 1921; the period may be extended by the Minister of the Interior to five years, suspending the provision of the regulations under which all ores mined on Dominion government lands must be refined in Canada. The only Canadian smelters on the Pacific Coast at which there is a possibility that the ore could be economically treated are those at Trail and Anyox, British Columbia, neither of which is prepared to accept the Yukon ore for treatment.

TUNGSTEN MINES IN AUSTRALIA ARE CLOSED

The wolfram mines at Hatch's Creek, Northern Territory, Australia, which, during the War furnished nearly half of the tungsten marketed throughout the world, have been abandoned, owing to the fall of the market and the high costs of production, according to a consular report. Although the quality of the ore is said to be first-class and the quantity available enormous, general opinion is that it would never pay to work the mines unless the price of the metal were at least twice what it is at present.

A. S. & R. CO. OUTPUT OF COPPER ABOUT 8,000,000 LB. IN JANUARY

The 8,000,000-lb. copper output of the American Smelting & Refining Co. plants in December was approximately duplicated during January. At no time has the big Garfield smelter been closed down, as sufficient ore has been available at all times to keep a small portion running. Material, which would ordinarily be sent to one or another of the Guggenheim plants, has been shipped to Garfield. With the promulgation of the new wage-scale the company now has the Garfield unit in readiness to handle concentrate from Utah Copper when that property shall resume. Although the daily scale was cut 40 and 50c., wages for this particular work still remain 25% above the level of the year 1914. The Tacoma plant has been running full on Kennecott product and shipments from the South American properties. All but one of the Mexican plants of the smelting company have been placed in operation and the management now has in consideration resumption at that one.

THE COPPER MARKET IN EUROPE

The London correspondent of the 'Boston News Bureau' writes, under date of January 9: "It is almost impossible to say how much scrap copper and brass remains in the hands of the foreign governments, dealers, and consumers, but we know that the various governments have been selling big blocks of material to dealers and various syndicates, and I have no doubt that the great bulk of the cartridge-cases, etc., has already been disposed of. There is no question but that as regards brass there is comparatively little 60-40 mixture left in the hands of dealers, for there was a big run upon this as soon as the material became released for sale. There is, however, a quantity of the 70-30 mixture, which is not liked much by the brass-people.

"I do not think the European governments have any surplus copper still on hand. They never had a great deal, and what they had was liquidated without difficulty, without resorting to the assistance of syndicates of dealers to take the material off their hands. There is a little improvement in the copper trade in Great Britain, but very little, and consumers are still running to a large extent upon scrap. I do not think that French consumption is improving much, and I am sure that this is the case in Italy, but there is no question but that Germany is the bright spot. You are familiar of course with the revolution of Germany's export business entailed by the collapse in the mark. I hear continually of orders for copper and brass goods being taken by Germany at prices below those quoted by British works, and as long as industrial chaos continues in this country, with extravagantly inflated charges for transport and labor, this position of affairs must endure.

"I consider the spurt in exports from America justified by the activity in Germany. I find that now and again dealers here have shipped from America small lots unsold, but the metal was marketed prior to arrival. The American Metal Co. some time ago tried the consignment business—but only on small scale—with, I believe, disappointing results. Of course the Copper Export Association holds some stock here and on the Continent as it is obliged to do, but they tell me that the quantity involved is not of importance."

COPPER IN THE BUTTE & SUPERIOR MINE

Butte & Superior stocks recently sold at 28½, the highest price in about two years. This is an advance of more than 18 points over the low of 10¼ touched in June of last year, and virtually 75% of the rise was accomplished in the last fortnight. In the summer of last year Butte & Superior, on its 2200-ft. level, entered an orebody that averaged, according to reports, 7.6% copper for the first 2 ft., the following 4 ft. averaging 6%, and the next 12½ ft. showing an average of 3.3% copper. This orebody became increasingly rich with depth and on the 2600-ft. level it was 18 ft. wide and assayed for the distance 5.2% copper. It is the intention of the company immediately to start sinking to the 3000-ft. level and to cross-cut for the copper vein again. The copper vein is in no sense any part of the well-known Rainbow lode which has been, and for a long time yet should be, a big silver-zinc producer for Butte & Superior. Copper-ore bins are now nearing completion at the Black Rock mine. The company has a stock-pile of ore from its new copper vein which approximates 3500 tons, and fully half of this averages 8% copper, the balance running around 4%. All this ore carries better than one ounce of silver to each per cent of copper, a credit to operating costs of no mean proportions. The opinion has been expressed that it would have to be a pretty big copper vein to warrant Butte & Superior changing from a zinc to a copper producer. There is no likelihood of this; whatever it gains from the copper-ore development will be in addition to its zinc production and will in no sense replace the zinc operations of the big Butte producer. Shifts at the company's Black Rock mine are steadily being increased. The aim is to have 1000 men at work, which will bring ore production up to the required 30,000 tons per month.

DECISION IN MINE-DEPLETION SUIT

An important decision regarding mine depletion has been made by the U. S. District Court of Minnesota in the case of Alworth-Stephens Co. v. E. J. Lynch, collector, according to a report from Washington. The court held that under the terms of the law in force in 1917, which permitted only net income to be taxed, the company was entitled, in figuring its net income and excess-profits tax, to allow for depletion to the extent of the market value in the mine of the product mined and paid for during the year; but that depletion should be figured on a risk-rate basis of 10% on the Perkins mine, and 8% on the Hudson mine, instead of on a 6% basis as contended for by the company. The assumed life of each mine was seven years. The court said there could be no question but that on March 1, 1913, the company owned a valuable property interest in both of these mines, and that the value of that property interest was approximately capable of definite ascertainment and should be determined on the basis above indicated. It could have sold it on that day for an amount calculated on the above indicated basis, and surely until the part of that amount represented by the ore taken out is deducted, there could be no net income or profit on such ore taken out. This allowance or deduction for depletion would not be a deduction for depletion as against the owner. Under the evidence in this case both the fee owner and the company would be entitled to such deduction, and both could get such deduction in full as to the ore taken out without exceeding the market value of such ore in the mines as of March 1, 1913. The court also held that the invested capital of the company was in 1917, $25,000, and that that invested capital could not be said to be not more than a nominal capital, and that, therefore, the levy and assessment could not be made under either Sections 209 or 210 of the Revenue Act. Concluding the court said that the levy and assessment should have been made by first allowing depletion upon the basis above indicated, and then determining the amount to be paid by considering the company as a corporation having an invested capital of $25,000.

ARIZONA

Globe.—It has been announced by W. G. McBride, general manager for the Old Dominion company, that operations at its mines will be resumed soon. The resumption will be gradual and there is a lot of repair and cleaning up work to be done. Actual production will not start till March it was announced.

Oatman.—It is reported that the United Eastern Mining Co. has purchased the El Tigre mine situated in the State of Nayarit, south-east of Mazatlan in Mexico. Negotiations have been under way for some time. The vein on the property is said to be 15 ft. wide. A rich streak along side the main orebody has been mined by the Mexicans to a depth of 50 ft. for a length along the outcrop of 1500 ft. The main orebody is said to be high-grade milling ore.

Contracts have been signed between the United American, Telluride, and Tom Reed mining companies whereby the latter company has agreed to mill the ore of the former companies. They have agreed to furnish not less than 50 tons of ore each per day. The charge for milling is to be

$2 per ton plus actual milling cost. Deliveries are expected to start within 30 days. Some slight alterations will be made in the mill in order to handle the ore. The Tom Reed is now milling 125 to 130 tons of ore per day which is being taken from that portion of the Sideline vein awarded to the Tom Reed in the recent court decision. The ore contains gold.

CALIFORNIA

Coulterville.—The Virginia gold mine, situated on the Mother Lode four miles from here, has just completed the driving of the north drift on the 900-ft. level, and has disclosed the continuation of the ore on that level. The main shoot is 300 ft. in length, 3 to 4 ft. in width, and ore being milled from this development averages about $15 per ton. A winze being sunk below the 900-ft. level has cut some rich ore similar to that found in the upper levels of the mine. Sinking of the main shaft is under way to the 1100-ft. level. The mine is one of the few gold mines that operated at a profit during the War. The property is owned by the Virginia Belmont Mining Co. and is fully equipped. W. V. Wilson is superintendent, and B. C. Austin is consulting engineer.

Forest.—High-grade ore has been opened on the 250-ft. level of the Kate Hardy mine. The new mill is running satisfactorily. The property is under bond and lease from William M. Beggs, of San Jose.——Besides the Kate Hardy, the Tightner, Sixteen to One, Twenty to One, and the Mugwump are producing some ore.

Quincy.—James Glynn, of Reno, president of the Plumas Eureka Annex Mining Co., is investigating the Jamison property, which adjoins the property of his company. It is believed that negotiations for the purchase of the Jamison, which produced profitably about 20 years ago, are nearly completed.

Sonora.—M. E. Layne has secured options and leases on 10 mining properties on Table mountain. It is said that pumping machinery with a capacity of 600 gal. per minute will be necessary to remove the water from some of the shafts. Millions of dollars worth of gold have been removed from the main channel underlying Table mountain, but many of the mines were abandoned on account of inability to handle the heavy ground. It is believed that modern methods will make possible the winning of much of the gold.

The buildings have been completed at the Parole mine and 20 men will be placed on development work. New machinery installed includes a hoisting engine, air-compressor, receiver, and air-drills. The mine is situated about three miles north of Soulsbyville.

Sutter Creek.—The first car of steel for the new headframe at the Central Eureka mine now is being hauled from the railroad to the mine, where the assembling of the new hoist is progressing rapidly. The excavation for the station and new ore-bins at the 4100-ft. level has been completed.

Wheatland.—A carload of copper ore is being shipped from Sheridan daily, according to announcement by A. L. Click of this city, who is in charge of the loading for the American Smelters Securities Co., which owns the ore, as well as the smelter at Selby to which it is going. The ore was hauled to a point on the railroad half a mile north of Sheridan prior to the time the Dairy mine, eight miles east of that point, was closed during the War. There is about 2,000,000 tons of the ore in the dump, according to Click, who announces he expects the ore shipments will not be concluded for at least two years. The narrow-gauge railroad which conveyed the ore to the broad-gauge line, has been torn up and the mine abandoned. Click says there is little probability that the mine will be re-opened.

Surface Plant of the Butte & Superior Company

COLORADO

Aspen.—The construction of the Park tunnel tramway is progressing and it is expected to be in operation inside of 60 days. It has been estimated that over 250,000 tons of ore is disclosed in the workings under Tourtelotte park, and the reserves are constantly being increased.——The old tunnels and passages on the Ferris properties are being cleared out, preparatory to extensive operations in the spring on the Hope and Midnight vein systems.——The Hope is continuing shipments, but no effort has been made to force production. It is proposed to increase the capitalization and a special stockholders meeting has been called for this purpose.

Breckenridge.—The Kokomo-Recen Mining & Dredging Corporation continues steady development of the Silver Queen group on Jacques mountain in the Consolidated Ten Mile Mining district of Summit county. Daily production at this time is averaging 20 tons, the ore sampling 60 to 80 oz. silver to the ton. Streaks in the vein have sampled as high as 600 oz. This company also owns the Hornsilver Bar placer which it will core-drill this spring.

Cripple Creek.—A promising ore-shoot has been opened on the south-western slope of Tenderfoot hill by the Heaton Leasing Co., operating in the Sangre de Cristo tunnel. The vein, new to the property, has been opened by drift for about 25 to 30 ft., between two and three feet of ore sampling two to five ounces gold per ton. The vein was cut while extending the tunnel to cut the Black Diamond vein, that has been producing high-grade ore from shallow workings.

Another 'outside' property, the Homestake, on Big Bull mountain east of Bull hill, and north-east of Victor, is again active under bond and lease. The property is being operated from the 1000-ft. level of the Golden Cycle mine, a long cross-cut having been carried out when that mine was controlled by the Milliken interests. Joe Carr, former superintendent of the Golden Cycle, and associates hold the lease and bond on the Homestake.

The Atlanta and Roanna at Independence, formerly owned by the Gilpin and Cripple Creek company, now owned by the M. J. Houlahan estate, has been leased by Denver parties who are preparing for work. The Atlanta shaft produced good ore prior to 1900 but has been inactive since that date. ——An electric hoist has been installed at the Hall and Kyner lease on the Rose Nicol Mining Co.'s property on Battle mountain. This replaces the steam-hoist formerly in use. Five sets of lessees are producing good milling ore and shipping about 150 tons weekly.

Idaho Springs.—The Pelican Dives, Seven Thirty, and Diamond tunnel properties have been sold to the East Butte Copper Co. of Montana and the first payment made. Preliminary work at both mine and mill has been started. The old Neshota mill is being overhauled and new machinery is to be installed.

Winfield.—The Molybdenum deposits near Winfield in Chaffee county, owned by the Kokomo-Recen Mining & Dredging Co., are to be operated in the coming spring. Plans are now being drawn for a concentrating plant to be constructed by the company.

IDAHO

Boise.—The Belshazza mine in the Boise basin is being operated. A working tunnel is being driven to tap old veins at a lower level. Several veins of good ore have been opened this winter and a raise to the old workings is now being made. The ore is pyritic; it is said to average $55 per ton in gold. It is planned to put a modern mill at the mine in the spring. The property is owned by the Ida-Wa company, its owners being chiefly Dakota and Iowa people.——The Gold Hill mine is now working 125 men. This mine has been a steady gold producer for over 40 years and is one of the few mines which operated steadily during the war period.

Cabinet.—According to reports heavier pumping machinery will be installed by the Carpie Mining Co. A drift from the 300-ft. level will be started. The Carpie is one of the best copper prospects in the Pend Oreille district.

Clayton.—The Red Bird mine, under the management of Robert N. Bell, has shipped 842 tons of concentrates to the Salt Lake smelters since last fall. These shipments totaled 653,310 lb. lead and 25,709 oz. silver. This mine is being operated at a profit despite a haulage of 60 miles to Mackay, the nearest shipping point.

Coeur d'Alene.—The Western Union Mining Co., operating north-west of Wallace, shipped 25 carloads of ore between November 19, 1920, and December 31, 1921, according to reports from Ben L. Collins, secretary-treasurer. The gross value of the ore was $72,248 and the net smelter returns $48,046. The average gross value per ton was $82, and the average net value $55. The average content of the ore was 39½ oz. silver and 48½% lead. Four sets of lessees are operating on the property. One of them is sinking from the tunnel-level, where ore in a body of increasing width is reported to have been disclosed.

Hailey.—The Compensation group of 16 claims near here has been bonded by a group of capitalists from Burley. The lease and bond, which runs for a period of three years, was given by L. A. Dithmer. The company taking over the property is capitalized at $250,000. They propose doing development work in the spring. The mine was formerly a silver-lead producer.

Mackay.—Harry P. Hunter & Co. has taken a lease on the lower tunnel of the Idaho Metals copper mine near here. Development work will start at once. This is one of Idaho's largest copper mining properties. The lease is on the 1500-ft. level.

MICHIGAN

Houghton.—Repairs are being speeded at the Calumet & Hecla mines preparatory to the resumption of production. The most extensive work is under way in the conglomerate department of the Calumet & Hecla. It is unlikely that all of these shafts will be ready for mining by April 1 for the vein in the lower levels has caved badly and a longer period will be required for the removal of broken ground, re-timbering and re-conditioning of shafts. Several of the shafts, however, doubtless will be in readiness to hoist from bottom workings. Two shifts of timbermen are at work in the Red Jacket and No. 2 and 4 shafts and it is probable that a third shift will be added. Repairs also are in progress at No. 5 and 6 Calumet, 6, 7, and 8 Hecla. Three shafts remain to be re-opened. It is probable that fully a thousand men will be employed in repairs.

Construction of the power-house and hoisting-plant at Gratiot No. 2 shaft, Seneca, will be started early in the spring. Work in the shaft will be temporarily suspended while concrete is poured for the collar of the shaft. All openings in Seneca continue in good ground and the drifts are being pushed steadily in the direction of Gratiot territory. Seneca now has a total of nearly 8000 ft. of openings.

Mayflower's north drift at the 1450-ft. level is in ground fairly well mineralized. This drift is now approaching a length of 200 ft. and there is no evidence of faulting. It is believed the disturbed area on the 1750-ft. level north is centred below the 1450 and the present work on the upper level will make it possible to determine the extent of the fault and simplify future development. The cross-cut from the 1750-ft. level is still in trap and unless the lode is picked up again a raise may be put in to penetrate the vein.

Six furnaces are now in operation at the Calumet & Hecla smelter, two of which are working on special orders and four smelting cupola blocks.

MONTANA

Anaconda.—Resumption of operations in the converter section of the Washoe smelter and an increase of 300 men in the working force, bringing the total number of employees at the smelter to 1500, was accomplished last week. A majority of the men were put to work early in the week, and a force sufficient to care for the normal flow of metal has been added since. With the opening of this unit, production of copper anodes will be started. Shipments will be under way to Great Falls soon. The opening of the converter plant will result in the resumption on a large scale of the refinery and rolling-mill at the Great Falls plant, with a consequent increase in the force at that smelter. Shipments of ore are being received at the smelter daily, and with the opening of additional mines at Butte plans are being made for an increase in the production of the smelter. An average of 4000 tons of ore is being treated at present, operations being about 65% of normal.

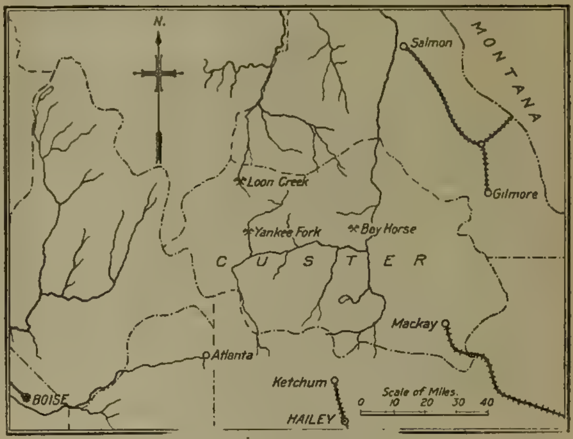
Butte.—The management of the Davis-Daly company has been negotiating with several companies regarding smelting arrangements. The East Butte smelter formerly handled Davis-Daly ore, but Davis-Daly felt that the smelting charges were too high, and it is therefore making an effort to secure better financial arrangements elsewhere. It is known, however, that East Butte since the recent reduction in wages and lowering of fuel costs has expressed a willingness to meet Davis-Daly part way in making new arrangements covering smelter-charges. Whether Davis-Daly will elect to have its smelting done by East Butte depends on negotiations now under way with other smelters. Officials of Davis-Daly have recently been in conference with Anaconda officials regarding smelting arrangements. It is also known that several smelters outside of Montana have expressed a willingness to handle Davis-Daly's ore. The Colorado mine has been closed down since the latter part of November. Development work continues at the Hibernia mine, where lessees are operating. This is strictly a silver mine. There have been no recent striking underground developments at the Hibernia mine, although a body of ore was recently uncovered which, with further development, may prove to be rich, but to date it has not come up to expectations.

A distinctly encouraging development by the East Butte company is the uncovering of an extremely rich body of ore on one of the lower levels at the Pittsmont mine. Officials of the company are reluctant to make any statement regarding the discovery until it has been proved beyond a doubt that the find is not a pocket of ore. Development work is now being pushed at this point and within another week or ten days it should be definitely established whether the showing is merely a pocket, or a large body of ore. Advices state that the find was made on the 800-ft. level, and that the ore carries from 6 to 9% copper, besides silver.

NEVADA

Divide.—The Tonopah Divide report for 1920 and 1921 contains no estimate of the ore in sight. William Watters, superintendent, says in the report: "No engineer's estimate has been made for the new ore that has been opened as a result of the development work done since E. A. Julian made his report, but it is certain that considerably more ore of shipping and milling grades has been developed by this work than the tonnages mentioned as having been extracted since Julian's report of 52,000 tons of ore averaging 20 oz. silver and 0.08 oz. gold was made". In 1921, 12,763 tons of ore was mined and the net recovery from this was $301,863. The cost of hauling the ore and treatment was $96,469. Mining, including development, cost $73,916.40. The net profit, with $5159 deducted for depreciation, was $101,560. A total of 3369 ft. of work of all kinds, exclusive of stoping, was done in 1921 at an average cost of $10.71 per foot. There is a total of 17,796 ft. of work, exclusive of stoping, in the mine. During 1920 and 1921, 22,752 tons of ore worth $26.48 per ton was shipped and 6346 tons worth $11.54 was placed on the mill dump. On December 31 the shaft was 1229 ft. deep. This is being sunk to water-level and of this the report says: "There is no definite information available which will permit of a prediction as to where the water-level will be encountered. However, it is hoped it will be reached within the next 200 ft. It is the intention to continue sinking to water-level and then to cross-cut to the vein just above this level and develop the vein thoroughly at this horizon to determine if workable orebodies occur. After this work has been completed the development of the vein on the 1100 and 1200-ft. levels will be resumed". It is "hoped and expected" that water ample for milling purposes will be found "so as to make feasible the mining and milling of the large tonnages of $8 to $15 ore which are now developed in the mine, but which will not stand the shipping costs".

Goldfield.—The Reorganized Kewanas has taken an option on the Nevada Eagle, four miles west of Goldfield, or toward the Montezuma district. The option extends for three years and the purchase price is $80,000. The first payment of $2500 has been made. The proceeds from ore shipped are to apply on the purchase price. The Eagle is an old mine in which $115,000 has been spent in exploring the vein to a depth of 250 ft. The shaft is 450 ft. deep and there is a level at 375 ft. on which the main vein is practically undeveloped. The Kewanas will work on the 375-ft. level. The drift on the 250-ft. level is 1725 ft. long, of which 1175 ft. is in the main vein, with 925 ft. in ore of an average value of $11.22 per ton, according to officials of the Kewanas company. Of this $2.38 is in gold and the remainder is in silver. Five raises driven an average of 50 ft. from the 250-ft. level are in these ore-shoots. The vein is 4 to 8 ft. wide.——The Silver Pick has ready for shipment from the lease on the Red Top 150 tons of ore of an average value of $20 to $25. This ore is being mined on the 260 and 333-ft. levels and on an intermediate level between. An average of 15 to 20 lessees and sub-lessees are working in the Consolidated and occasional shipments are being made.



Map of Central Idaho

Hornsilver.—The Orleans Hornsilver is sinking a winze from the seventh level, the first work done below this level. The south-east drift on the seventh level is in an 18-ft. width of ore caused by the joining of the foot- and hanging-wall ore-shoots. A raise to the fifth level from the sixth has proved ore between these levels, and the south-east drift on the fifth level is to be continued over the drifts in this direction on the levels below. An engineer for the Tonopah Mining Co. is again sampling the Orleans.

Montezuma.—The Harmill shaft is at about the 150-ft. point and the ore-shoot exposed on the 50- and 100-ft. levels is appearing in the shaft, a 6-in. width assaying 21 oz. silver and 55% lead, with a small gold content. This 6-in. width represents the extreme north-eastern edge of the shoot, which on the 50- and 100-ft. levels has been opened for a length of 35 ft. On the 50- and 100-ft. levels the shoot is 3 to 5 ft. wide and will break at $115. A sample of the face of the drift on the 100-ft. level gave an assay of 0.08 oz. gold, 42.92 oz. silver, and 69.50% lead, a total value of $123.50.

Stonewall.—The Sterlag tunnel of the Yellow Tiger has been driven 1000 ft. and it is expected that the contact vein which is the first objective of the work will be entered in a short distance. The tunnel will cut into the vein at a depth of 400 to 500 ft. For the last 700 ft. the tunnel has been in extremely hard porphyry, but a softer formation should soon be found.

OREGON

Huntington.—The Bayhorse mine, situated just across the Snake river in Oregon, has built a spur preparatory to shipping ore to the smelter at Tacoma, Washington. At this mine there are some 16 cars of ore on the dump ready for shipment. This is a silver property which is being developed after being idle for many years. The ore runs from 37 to 132 oz. silver per ton with a few streaks of high-grade assaying as high as 1500 oz. The ore is a blue-gray porphyry with disseminated argentite. It is owned by the U. S. Metals Co., of Spokane.

UTAH

Alta.—A meeting of stockholders of the Sells Mining Co. has been called for February 7, to vote on the proposed sale of the company's entire holdings to the South Hecla Mines Co. It is proposed to exchange one share of South Hecla stock for four shares of Sells stock. This would result in the South Hecla increasing its capitalization by 250,000 shares. The deal is considered a favorable one for the Sells stockholders, as they have been called upon to pay several assessments, and the mine has never been thoroughly prospected. The Sells Mining Co. owns 35 acres of patented ground, from which ore, estimated to be worth $250,000, has been mined. The property has been opened by a drift from the South Hecla workings, from which it can readily be drained and economically developed.

A 40-ton shipment of ore from the Emma mine gave returns of 39 oz. silver and 5% lead. M. M. Johnson, consulting engineer to the company, reports that exploration work is being confined to the Montezuma fault.

Eureka.—A banquet was given by officials of the Chief Consolidated Mining Co. to employees of the Walter Fitch, Jr., Co., who participated in the world's record for shaft-sinking at the Water Lily shaft. Each employee was presented with a silver medal. The banquet was attended by about 100 men, all of whom are interested in the mining business. J. Fred Johnson, superintendent of the Chief Consolidated, presided at the meeting, and Walter Fitch, Sr., president of the company, gave an interesting talk, in which he brought out points of interest to the mining profession, especially as applied to the Tintic district.

George Nicholes and associates have appealed to the State Supreme Court the decision given in the Third District Court recently, whereby Charles Zabriskie and associates were held to be the duly elected directorate of the Lehi-Tintic Mining Co. Zabriskie has been president of the company for several years past, and was recently re-elected. The Third District Court held that the election of Zabriskie was legal.

A second shipment of bonanza ore has been made by lessees in the Iron Blossom mine. The first shipment consisted of 45 tons, and assayed 788 oz. silver and 30% lead, netting the lessees about $35,000. This was one of the richest cars of ore ever shipped from this district.

E. R. Higgenson and associates have taken a lease on the old Star mine, which is a part of the Empire Mining Co., owned by the Jesse Knight interests. It is planned to confine operations to the territory between the 220-ft. level and the Gundry tunnel. Samples recently taken give returns of $10 to $15 per ton, principally in gold and silver. It is planned to ship the ore to the plant of the Tintic Milling Company.

Ore shipments for the week ending January 21 totaled 145 cars, of which the Tintic Standard shipped 51; Chief Consolidated, 40; Iron Blossom, 11; Victoria, 10; Eagle & Blue Bell, 9; Colorado, 4; Grand Central, 4; Bullion-Beck, 4; Gemini, 3; Dragon, 3; Showers, 2; Centennial-Eureka, 1; Gold Chain, 1; Sunbeam, 1; Swansea, 1. Shipments the previous week totaled 152 carloads.

Nephi.—Patrick Conley, of St. Paul, Minnesota, has been awarded a one-sixth interest in the Boston and Mohogany groups of claims in the Deep Creek mining district, according to a decision handed down by Judge W. F. Knox. Conley brought suit against the Boston-Deep Creek Mines Co. and others, claiming that he was entitled to a sixth-interest in the claims, which were recently sold, under an option, for $200,000, and have since disclosed a showing of high-grade silver-lead ore.

Park City.—Shipments of ore for the week ending January 21 totaled 2024 tons, as compared with 1983 tons for the previous week. The Judge allied companies shipped 912 tons; Silver King Coalition, 823; Ontario, 289.

Salt Lake City.—The American Smelting & Refining Co., the United States Smelting Co., and the International Smelting Co. have announced a decrease in wages. Employees receiving more than $3.75 per day will be reduced 50c. per shift, and those receiving less than $3.75 will be cut 40c. per shift. This action was taken to conform with the 50-cent reduction announced by Utah mine operators on January 16.

BRITISH COLUMBIA

Alice Arm.—The Government wharf has been completed, and shippers are no longer dependent on the Taylor Mining Co.'s wharf. The first 100 tons of ore from the Esperanza mine has been sacked, and is being shipped from the new wharf to Anyox.

Lillooet.—At a meeting of the Anderson Mining Co. on January 14, it was decided to re-open the mine immediately. The mine is situated on Anderson lake, 7 miles from the P. G. E. railway; some promising veins have been opened and a stamp-mill has been erected. All work was stopped at the outbreak of the War, and has not been resumed since.

Prince Rupert.—H. S. Munro, general manager for the Granby company, passed through here recently on his return to Anyox, after a conference with the directors of the company, in New York. Munroe stated that there was no foundation for the rumor that the company proposed to build a smelter at Stewart, but that he did expect a good deal of ore from the district would be treated at the Anyox smelter during the present year. The company has practically concluded to add to its power system by the addition of a reservoir of 25,000 acre-foot capacity, about one and a half miles farther up Falls creek than the existing dam. This will guarantee sufficient power through the winter, when the present system sometimes falls inconveniently short. Other improvements under consideration will depend upon the copper market.

Victoria.—A. W. B. Allen, of this city, is endeavoring to re-organize the affairs of the Lucky Jim mine, in the Slocan, by the formation of the New Lucky Jim Mines, Ltd. The new company proposes to issue 250,000 preferred shares at $1 each and 2,500,000 common shares at 10c. each, and for every dollar invested in common stock the investor will receive as a bonus one preferred share and the option of purchasing 30 shares of common stock at 3c. per share. The provisional directors are: Lendrum McMeans, of Winnipeg, who owns a second mortgage for $35,000 on the mine, T. S. McPherson, M. P. Blair, J. J. Collinson, A. W. B. Allen, all of Victoria. The Lucky Jim has seen many vicissitudes, but mining men, as a rule, consider it to be a good zinc mine.

MANITOBA

Rice Lake.—North of Hole River, that is to say at the extreme north-westerly extension of the Rice Lake field, interests connected with the Hollinger have taken an option on the Huronian group; a force has been working since last spring. A three-foot vein has been traced for several hundred feet on the surface. It is thought the option will be exercised and the group turned over to the Hollinger company.——A mile or two farther south-east the Selkirk Mining Co. has half a dozen men at work under Frank Phillips. This property is equipped with a 20-stamp mill, but no stoping ground has been blocked out. However, the vein is traceable for 3000 ft., and samples as high as $160 per ton have been obtained. The reason the mill is up before the mine is ready to feed it, is that an opportunity arose to pick up a complete plant at the price of junk.

MEXICO

Arizpe.—The Santa Maria claim contiguous to the Chispas mine of the Minas Pedrazzini Gold & Silver Mining Co. was recently thrown open for denouncement and the mining agent Juan Moreno reports that 141 denouncements were made by rival contestants. Several local mining companies had large numbers of denouncements filed but a barber from Arizpe won with a single entry.

Concepcion del Oro.—The mines and smelter owned by the Mazapil Copper Co. in the State of Zacatecas were reopened on February 1. They include the Aranzazu mine, with an output of 15,000 tons per month; Cata Arroyo, with a tonnage of 6000; and San Eligie, with 3000 per month. The company also operates a smelter at Concepcion. R. H. Jeffrey is general manager; J. P. Bandy, general mine superintendent; R. T. Wilder, smelter superintendent; J. B. Gaiyzt, superintendent, San Eligie unit; F. F. Seifert, mechanical engineer; and O. V. Seifert, superintendent, Cata Arroyo unit, are the other officials.

El Tigre.—Neill and Hamilton are doing development on the Angustias property, recently denounced by them, situated about 9 miles south of El Tigre on the same range. A wide vein carrying silver of good milling grade is reported. ——Sam King representing the Last Chance Leasing Co. of Bisbee is reported to have options on several promising prospects and mines in the El Tigre and Pilares de Teres districts.——A steady stream of high-grade ore from the Pilares de Teres district or (cinco de mayo), to the value of about $6000 per month goes through the hands of ore-buyers. The company holding the lease on the claims of the Garcia interests plans to put in a 200-ton lixivation plant. The wide diversity of the ores in this locality and the copper content make any other system of recovery unfeasible. Ore carrying as high as 100 oz. silver has been thrown away in the dumps and fill because the freight to the railroad was prohibitive.

Nacozari.—R. W. Brown, of Kansas City, managing director of the Sonora Development Co., in company with P. H. Pernot, has been here for the past week inspecting the mines of his company. Among the properties visited were the Grand Republic group which is producing high-grade silver ore carrying copper and lead, and the Madrugada group west of Nacozari. The Don Genaro, a large low-grade lead mine west of Moctezuma, that was worked by the Spaniards for smelter fluxes, was examined, as was the Westerholm, a quartz lode in the Guerigito district northwest of Cumpas. The company is planning extensive exploration and development in Mexico.

ONTARIO

Boston Creek.—At the Walsh property the vein which has been cross-trenched at intervals for a distance of 700 ft. shows a width of about 12 ft. with a pay-streak carrying visible gold and yielding good assays.

Gowganda.—The shareholders of the Trethewey on January 19 adopted the by-law authorizing the formation of a new company to be known as the Castle Trethewey Mines, Ltd., to assume all the liabilities of the Trethewey, the shareholders to receive one share of stock in the new company for every four shares in the old one. A sale of 1,600,000 shares will be effected, the shareholders being offered the right to purchase a limited quota of the same at 10c. per share.

Kenora.—Gold mining shows signs of a revival in this part of New Ontario, as well as in the adjacent regions of Manitoba. Favorable factors induce capitalists to provide the required funds. First, labor is to be had for its cost during the War, and the men now do a fair day's work. Any amount of pick and shovel laborers may be hired at a dollar a day; second, the price of supplies has fallen to almost pre-war quotations; and third, since gold may only be disposed of to the Dominion Mint, and is paid for in American funds or their equivalent, gold producers receive the difference between the value of the Canadian and the American dollar, which is, today, about 6%—a bonus well worth having. A strong company composed of Kenora and Toronto men is re-opening the old Mikado mine, shut-down for many long years. The tailing heap contains 30,000 tons, which assays $4 per ton, showing that the saving could not have been over 60% of the gold content. There was no attempt at cyaniding, and flotation had not been thought of. As a lot of the gold is intimately mixed with sulphides of copper and iron, it is probable flotation will play an important part in the winning of the metal, though the flow-sheet has not as yet been worked out. The Mikado Mines, Ltd., has secured options on the Tycoon and Bullion properties adjoining the Mikado.

Kirkland Lake.—A movement has been started for the extension of the Kirkland Lake road in an easterly direction through Gauthier Township to the Argonaut mine at Beaverhouse Lake. The intermediate territory has been all staked by prospectors and gold has been found at intervals all along the way.

The Teck-Hughes last week shipped a gold bar valued at upward of $40,000 and indications point to a large increase in the output of the company. Development work at the 600-ft. level shows the ore to be increasing in richness. The orebody has been opened up for 375 feet.

Lake of the Woods.—A new company capitalized at $5,000,000 has been organized to re-open and operate the Mikado mine and the adjoining Tycoon and Bullion properties.

Porcupine.—A statement issued by the Dome Mines covering the period of nine months ending December 31 shows operating earnings of $694,626, as compared with $706,894 for the year ending March 31 last. The total income for the nine months period was $800,659, as against $954,250 for the previous year. The profits, after deductions for taxes, depreciation, and exhaustion of mine, were $283,004, compared with $302,479 for the previous full year. The company has decided to commence the repayment of capital. The first capital payment of $1 per share will be made on April 20 to shareholders of record March 31. The company will continue to pay regular dividends at the rate of 2½% quarterly.

The Plat Veteran property of 160 acres, on which diamond-drilling has disclosed gold at depth, has been purchased by a Montreal syndicate headed by McCuaig Bros. & Co. for a price stated at $300,000. Active development will be started early in the spring.

At the Hayden-Porcupine, where development was resumed last fall, good progress is being made. The main shaft is being put down from 300 ft. to the 400-ft. level, and the 100-ft. level is being drifted on.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

John J. Alves, of Oakland, is at Colima, Mexico.

H. E. Queen, of Berkeley, is at Kingman, Arizona.

L. A. Meyer has left Santa Cruz for Ruth, Nevada.

Spencer Bishop, of Berkeley, is at Morenci, Arizona.

A. W. Newberry, of New York, is at El Paso, Texas.

John E. Corrette, of Butte, is at the St. Francis hotel.

Raleigh P. Trimble, of Portland, is at the Fairmont hotel.

C. F. J. Holloway has left Sarawak, Borneo, for England.

Fred V. Burns, formerly at Houston, Texas, is at Tampico, Mexico.

J. W. McBride has returned to Seattle from Livengood, Alaska.

F. C. Floss has moved from Milwaukee, Oregon, to Miami, Arizona.

R. L. Chase, of Denver, is at Indianapolis on professional business.

L. D. Yundt has moved from Bayhorse, Idaho, to Salt Lake City, Utah.

J. H. Rose has left Simon, Nevada, and is at Tacoma, Washington.

W. G. Hubler is now with the Simon Silver-Lead Co., at Mina, Nevada.

R. L. Amidon, of Cornucopia, Oregon, will be at Seattle for the winter.

W. B. Tucker, recently at Chihuahua, Mexico, is at Redding, California.

C. H. McMahan has moved from Kirkland, Arizona, to Denver, Colorado.

J. H. King has moved from Bonanza, Colorado, to Lordsburg, New Mexico.

W. H. Johnston is with the Waihi Gold Mines company, Waihi, New Zealand.

Bulkeley Wells is expected on the Comstock this week, on his way to San Francisco.

Walter Harvey Weed has returned to New York from the Porcupine district, Ontario.

Rienzi W. MacFarlane has left the Arizona Copper Co. and is now at El Paso, Texas.

W. H. Loerpabel is with the Britannia Mining & Smelting Co., at Britannia Beach, B. C.

Philip Wiseman has been re-elected vice-president of the Los Angeles Chamber of Mines.

R. A. Schumacker has returned from Rancagua, Chile, and is now at Red Hook, New York.

H. W. Heidman is now manager for the Golskeish Mines, Ltd., at Anyox, British Columbia.

J. H. Curle writes from Johannesburg, after extended travels through Morocco and Senegal.

James W. Wade has been appointed superintendent of the Tintic Standard mine at Eureka, Utah.

Walter M. Briggs has been on a visit to Ajo, Arizona. He is living now at Pleasanton, California.

F. C. Black, of Santa Cruz, is now with the Nevada Wonder Mining Co., at Sonora, California.

Vernon S. Rood, general manager for the Utah-Apex Mining Co., at Bingham, Utah, is in New York.

A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress, is at Washington.

A. V. Kiassom, of Glendale, California, is now with the Cananea Con. Copper Co., at Cananea, Mexico.

Edward R. Zalinski has returned to Salt Lake City, after professional work in Mohave county, California.

Carl G. Schluederberg, of the Westinghouse Electric & Manufacturing Co., left New York City recently on an extended trip to South America. He will visit Chile, Peru, Uruguay, Paraguay, and Brazil.

C. G. Patterson, of Piedmont, is now with the Butters & Davenport San Albino mines, at Jicero, Nicaragua.

E. J. Franklin, consulting mechanical engineer for the Ray Consolidated Copper Co., is at Salt Lake City.

M. M. O'Brien is with the Consolidated Mining & Smelting Co. of Canada, at Kimberley, British Columbia.

Rush T. Sill has returned to Los Angeles from examination work at Randsburg and Slate Range, California.

George M. Fowler, geologist for the International Smelting Co. at Salt Lake City, has been in the Pioche district.

Frank R. Corwin, of Humboldt, Arizona, has been visiting the Western mining districts, and is now at Los Angeles.

Walter R. Vidler is engaged in petroleum engineering in Texas and Oklahoma, with headquarters at Graham, Texas.

T. A. Janney, chief metallurgical engineer for the Utah Copper Co. at Garfield, Utah, spent a few days at Butte recently.

Victor C. Heikes, representative of the U. S. Geological Survey at Salt Lake City, has returned home from Washington.

Robert A. Bryce and **George C. Bateman**, mining engineers, are now at 8 Wellington street east, Toronto, Ontario, Canada.

Duncan S. Smith, mining engineer for the Katanga Goldfields company, in the Belgian Congo, has been in San Francisco.

G. T. Jackson, superintendent for the Shasta Zinc & Copper Co., has left the San Francisco office and is now at the mine, near Winthrop.

Leo Atcheson, who has been leasing in the Tintic district, Utah, has accepted a position with the Braden Copper Co. He sails for Chile today.

Richard A. Parker, accompanied by his wife, sails on February 25 from New York with the intention of remaining in Europe until November.

Cyril J. Emery, manager of the British Mine, Broken Hill, New South Wales, has returned to Australia after visiting England and the United States.

Walter S. Larsh, underground mine superintendent for the Nevada Consolidated Copper Co. at Ruth, Nevada, has been spending a few days at Salt Lake City.

H. F. Mason is now with the American Republics Corporation, New York City, having resigned from the position of petroleum economist on the staff of the U. S. Bureau of Mines.

Obituary

Steve Donaldson was killed as the result of a blasting accident at the Beaver-Kirkland mine, Kirkland Lake, Ontario, Canada, on December 12, on which property he was mine captain. He leaves a widow and three children.

Quay Simons, a lessee in the Grand Central mine at Eureka, Utah, died at the Holy Cross hospital in Salt Lake City on January 13. He was born at Payson, Utah, on January 16, 1896. He enlisted in the navy three days after war was declared, on April 6, 1917, being assigned to transport service on the Atlantic. On January 9, while climbing a ladder in the mine, he slipped, fell 40 feet, fracturing his skull. He never regained consciousness.

William E. West, 60 years of age, for the past twenty years one of the best known ore-sampling experts in the inter-mountain country, died at his home in Salt Lake City on January 17, after a prolonged illness. For the past five years he has been smelter representative for R. H. Officer & Co., assayers, of Salt Lake City. Prior to that he was superintendent of the sampling department at the Garfield smelter for a number of years.

Company Reports

SUPERIOR & BOSTON COPPER CO.

Report for the year ended September 30, 1921.

Property: Mines in Arizona.

Operating Official: E. G. Deane, mine manager.

Financial: Receipts, $244,021.63; disbursements, $280,086.64

Development: 5835 ft. of development and 1036 ft. of diamond-drilling.

Production: The copper smelters of the South-West closed in April, forcing the company to stop, for a time, the production of ore. Until then the company had shipped 11,107 tons of ore assaying 4.37% copper and 5.88 oz. silver, for which $95,022.74 was received, after deducting freight and smelting charges.

General: Asbestos was found outcropping about 200 yards north of the McGaw shaft. Work on this was discontinued when it was determined that most of the fibre was too harsh to be of commercial value, although a little very good fibre was found. Work underground disclosed the fact that there are a number of places well worthy of development as soon as conditions warrant.

MEXICAN CORPORATION, LIMITED

The annual report of the Santa Gertrudis company contains a statement that the general manager of the Mexican Corporation estimates that with the treatment of 75,000 tons per month, the gross working profit from the quarry orebody will be $75,000 per month, with silver selling at 62½c. per ounce. The terms of the revised agreement with the Santa Gertrudis company provide that in consideration of the Mexican Corporation company increasing the milling capacity of the Fresnillo plant to this amount the resulting profits are to be allocated as follows: 20% to be retained by the Corporation until the excess expenditure (up to $800,000) in constructing the plant over the original estimate has been amortized; the remaining profits will then be divided equally between the Corporation and the Fresnillo company, until a sum of $5,000,000, including the $800,000 or less referred to, has been received by the Mexican Corporation. Afterward the division of profits will revert to the basis fixed in the original agreement. Drainage of the old workings and commencement of exploration will be undertaken on the completion of the construction work mentioned above.

At the Tezuitlan property, smelting operations were discontinued owing to the low price of copper. Recent development work has met with encouraging results, a high-grade orebody having been struck at a point indicated by previous diamond-drilling.

MOUNT LYELL MINING & RAILWAY COMPANY

Report for the year ended September 30, 1921.

Property: Mines, plants, and railway in Tasmania.

Financial: The working account shows a profit of £133,531 3s. 9d. After deducting £4459 10s. 4d. for prospecting and development, and £48,590 7s. 8d. for depreciation of mine plant, the net profit from all sources amounts to £51,830 2s. 3d.

Ore-Reserves: Ore-reserves have been re-calculated and a substantial addition has been shown. They now consist of: Mount Lyell mine, including the South Lyell mine, 1,711,088 tons containing 0.50% copper, 1.50 oz. silver, and 0.04 oz. gold; North Mount Lyell mine, 1,095,981 tons containing 6% copper, 1.33 oz. silver, and 0.05 oz. gold per ton.

Production: 152,732 tons of material was smelted during the year. The contents of 5786 tons of blister copper produced was as follows: copper, 5738 tons; silver, 178,380 oz.; and gold, 4744 ounces.

General: In the concentration plant the sorting section came into operation on February 24. The capacity of the milling section has been increased by the installation of a Hancock jig and other equipment. The flotation plant has been extended and improved during the year. A new Dwight-Lloyd sintering machine is being erected.

CIA. DE SANTA GERTRUDIS

Report for the year ended June 30, 1921.

Property: Mines at Pachuca, Mexico.

Operating Staff: C. A. Lantz, general manager; F. H. Walsh, general superintendent; J. F. Berry, mining superintendent; W. J. A. Palmer, purchasing agent and chief clerk.

Development: 1297 ft.; ore-reserves, 309,911 tons, containing 17,144 oz. gold and 2,986,530 oz. silver.

Production: 201,094 tons of ore was sold containing 12,170 oz. gold and 2,119,409 oz. silver.

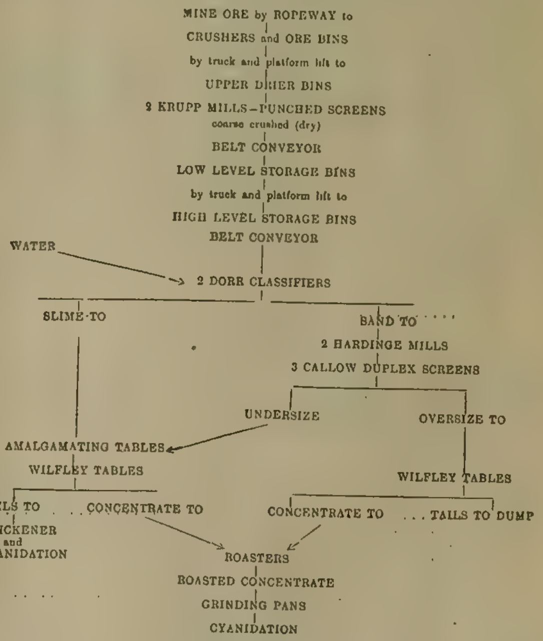
General: Operating conditions continued to improve until the end of last January, when unexpected advice from the power company gave notice of a shortage of power and an immediate necessity of reducing consumption by 25%. This condition has continued to date without sign of relief. The precipitate and heavy decline in the price of silver affected the earning power of the mine, and forced the suspension of operations on a number of low-grade areas.

ASHANTI GOLDFIELDS CORPORATION

Report for the year ended June 30, 1921.

Property: Mine and mill in West Africa.

Financial: Income, £393,144 5s. 10d.; working costs, £231,491 14s. 9d.; deductions for mine development, royalty, depreciation, and reserve for profits tax, £81,773 18s. 9d.; net profit, £79,878 12s. 4d.; dividend paid, £50,000.



Reserves: 511,400 tons of a gross value of £2,451,500.

Production: 62,259 tons for a yield of 68,817 oz. gold, plus 233 oz. obtained from sundry sources. The output realized a total of £383,168 10s. 5d., the gold premium accounting for £89,744 1s. 6d.

General: The erection of the wet-grinding and concentrating plant, delayed by labor difficulties, is now complete and regular operations are expected to be commenced this month. A flow-sheet of the new arrangement is shown herewith.

THE METAL MARKET

METAL PRICES

San Francisco, January 31

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	14.25—14.75
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$105
Platinum, 10% iridium, per ounce	$115
Zinc, slab, cents per pound	6.50—7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

January 30.—Copper is inactive and easy. Lead is quiet and firm. Zinc is dead and lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Jan.	24	65.50	35.00	Dec.	19	66.08	35.60
"	25	65.37½	35.00	"	26	65.50	35.25
"	26	65.12½	35.00	Jan.	2	64.82	34.90
"	27	65.12½	34.87½	"	9	64.90	34.83
"	28	65.50	35.12½	"	16	66.06	35.31
"	29 Sunday			"	23	65.27	34.90
"	30	66.12½	35.37½	"	30	65.46	35.06

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	68.24
June	110.50	90.84	58.51	Dec.	131.92	64.78	65.76

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Jan.	24	13.50	Dec.	19	13.58
"	25	13.50	"	26	13.62
"	26	13.50	Jan.	2	13.62
"	27	13.50	"	9	13.56
"	28	13.50	"	16	13.62
"	29 Sunday		"	23	13.54
"	30	13.37½	"	30	13.48

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	13.54

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Jan.	24	4.70	Dec.	19	4.70
"	25	4.70	"	26	4.70
"	26	4.70	Jan.	2	4.70
"	27	4.70	"	9	4.70
"	28	4.70	"	16	4.70
"	29 Sunday		"	23	4.70
"	30	4.70	"	30	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	4.70

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	32.49

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Jan.	24	5.00	Dec.	19	5.19
"	25	5.00	"	26	5.23
"	26	4.95	Jan.	2	5.17
"	27	4.90	"	9	5.16
"	28	4.87½	"	16	5.11
"	29 Sunday		"	23	5.04
"	30	4.87½	"	30	4.93

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	5.24

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Jan.	3	50.00	Jan.	17	50.00
"	10	50.00	"	24	50.00
			"	31	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	40.40
June	94.40	85.00	49.50	Dec.	95.00	52.50	49.50

THE OUTLOOK FOR ZINC

The chilling effect of low metal prices congealed the entire zinc industry in 1921. Recoverable zinc contents of ores mined fell off about 60% from the reduced rate of 1920, or from 584,772 tons to 250,000, following general mining curtailment and suspension, says the 'Financial Review'.

Foreign movement was practically extinguished. Unsold metal stocks increased slightly, while unmarketed concentrate supplies registered a substantial expansion. The formidable metal and ore accumulations overhanging the market constitute the weakest factor in the zinc situation. Disappearance of zinc-ore imports was almost complete, with only 2700 tons last year, against 22,487 in the preceding period. Foreign shipments of slab-zinc, however, increased alarmingly to 6674 tons, as compared with only 15 in 1920. This movement was accelerated by demoralized foreign exchange, making it highly advantageous to sell in our markets.

Export movements collapsed completely, to 4460 tons total, against 114,266 in 1920. Prospects for regaining foreign markets acquired during the War are not bright, as zinc may be more economically produced abroad from local or Australian ores, with 'cheap' European labor. As usual, the Joplin district led the entire country, with a 1921 quota of 164,000 tons of recoverable zinc. Eastern States are credited with 68,000. Western production of only 14,000 tons reflects general suspension of operations. Primary zinc output is placed at 194,000 tons, leaving 56,000 to supply the pigment and rubber trades.

Domestic smelter stocks of zinc are estimated close to 75,000 tons at the year-end. World metal accumulations are placed between 200,000 and 250,000 tons. Zinc in concentrate on hand in this country is set at 150,000 tons, of which 70,000 represents the quota of the Joplin district. Foreign concentrate stocks have attained even more formidable proportions. Accumulation of Australian concentrate is placed at 70,000 tons. At the end of August the British government reported 665,566 tons on hand, for which any reasonable bid would be considered. This material cost 92.7 and 83.9 shillings per ton, f.o.b. Port Pirie, under the terms of the 13½-year contract signed January 1, 1918.

Rhodesia Broken Hill, in South Africa, has 50,000 tons of concentrate on hand. Other huge supplies are in Burma, North Africa, Spain, and central European countries. This country leads in high-grade ore resources, suitable for retorting of purest zinc. The growing importance of electrolytic-treatment methods, however, may gradually eliminate this advantage. Next year the Risdon, Australia, plant should be producing at the rate of 35,000 tons annually, on a lower cost basis than any other competitor.

Our own electrolytic plants are those of Anaconda, rated at 60,000 tons annually, and the small Judge mill, with 2500 tons yearly capacity. The Consolidated Mining & Smelting Co., at Trail, B. C., operates a 25,000-ton electrolytic plant. Domestic production of electrolytic zinc amounted to 51,626 tons in 1920, although only 255 in 1915. Quotations on prime Western zinc sank to a 14 years' 'low' at 4.12½c. per pound in 1921. The average for the year was 4.67c. Although some further improvement in zinc prices is indicated, the statistical position of the industry is not particularly encouraging. Extensive upward price movements are threatened by formidable unsold metal accumulations overhanging the market.

MONEY AND EXCHANGE

Foreign quotations on January 31 are as follows:

Sterling, dollars:	Cable	4.28½
	Demand	4.27¾
Franc, cents:	Cable	8.33
	Demand	8.30
Lira, cents:	Demand	4.61
Mark, cent:		0.50

Eastern Metal Market

New York, January 25.

Extreme dullness pervades all the markets except that of lead and prices are lower.

Demand for copper is very light; quotations are easier.

Tin is cheaper than a week ago on a sharp decline in London, but buying has been good.

The lead market is steady and strong with a good demand.

Buying of zinc could hardly be lighter and prices have fallen.

Antimony is unchanged.

IRON AND STEEL

While orders for steel are coming in considerable numbers, the volume is not impressive, and uncertainty as to the course of prices is not relieved. On the one hand is the expectation, long disappointed, of lower freight-rates; on the other hand, the expected coal strike would mean scarcity and higher prices in coal, coke, pig-iron, and steel. Thus far precautionary buying is not a measurable factor in any of these lines.

With the ups and downs of steel-works operation in January, shown in a range of 40 to 50% for the Steel Corporation and 25 to 40% for the larger independent companies, the rates of new buying has been little changed. The variations have been chiefly in the rate at which mills have replenished buyers' stocks in the different lines.

It is considered a favorable sign that the mills have kept so well up to the rate of December, with the prospect that the present pace can be held pending the appearance of the so-called seasonal demand of February or early March.

COPPER

There has been no improvement in demand and prices are weakening. Large consumers who bought heavily in the last quarter of last year are not in the market, which explains the light demand. Buying therefore is easily satisfied by offerings from large and small dealers who are taking this business at 13.75c., delivered, or 13.50c., New York or refinery, for first quarter, with some second quarter business done at 13.87½ to 14c., delivered. Large producers generally are out of the market and have been for some time. Lake copper is easier at 13.75c., delivered.

TIN

The feature of the market is the premium on spot and January delivery Straits tin. From last Tuesday, January 17, to Saturday, January 21, there was a fairly active market, the first day being the liveliest. On that day, with dealers the buyers, 400 to 500 tons changed hands and by the end of the period the total had been brought up to about 900 tons. On the 17th, January metal sold at 32.12½c. The premium referred to has been about ½c. per pound and the cause has been either a scarcity or the position of the metal in strong hands. On Monday of this week, however, the London market broke £4 per ton; but this did not bring in buyers on this side with the result that the market was dead. It was not much better yesterday with the quotations for spot Straits at 31.25c., New York. Quotations in London yesterday were £158 10s. for spot standard, £160 for future standard, and £160 10s. for spot Straits, or about £5 per ton below those a week ago. Buying in London on yesterday and Monday was heavy at 2390 tons for the two days. Arrivals thus far this month have been 3685 tons with 5185 tons reported afloat. Chinese tin at low prices is being freely offered in this market.

LEAD

There is a good demand from consumers characterized by the same steadiness which has prevailed for many weeks. Chief buyers at present are in the pigment and battery industries. Prices are steady and remain at levels which have existed for many weeks or since late in September. The leading producer quotes 4.70c., both New York and St. Louis, while independents are taking business at 4.40c., St. Louis, or 4.70 to 4.75c., New York and Eastern points.

ZINC

Demand is so light that the extreme dullness of last summer is vividly recalled. What little buying is reported is confined to small and carload lots for early delivery from a few consumers who have a few orders for finished material. Prime Western for early delivery is quoted at 4.65c., St. Louis, or 5c., New York, light orders being taken at these prices. This is about ⅛c. per pound below a week ago, but not as low as the low point last summer when the quotation was 4.15c., St. Louis.

ANTIMONY

In a quiet market, prices for wholesale lots are unchanged at 4.45c., New York, duty paid, for early delivery.

ALUMINUM

Depending on the quantity, wholesale lots of virgin metal, 98 to 99% pure, are quoted by the leading interest at 19 to 19.10c., f.o.b. plant, for early delivery. The same grade from importers is obtainable at 17.50 to 18.50c., New York, duty paid.

ORES

Tungsten: Interest in the market is absent and quotations are nominal at $2 per unit and higher, depending on the grade of ore and the quantity.

Molybdenum: Quotations are nominally unchanged in a quiet market with 45 to 50c. per pound of MoS_2 in regular concentrate the prevailing quotation.

Manganese: Chief interest lies in the purchase of 20,000 to 30,000 tons of high-grade Brazilian ore by the Jones & Laughlin Steel Co., Pittsburgh, at 22c. per unit, seaboard. This is the first business in many months and establishes a quotation.

Chrome: Demand is absent and quotations are nominally unchanged at $20 to $28 per ton, f.o.b. ports.

FERRO-ALLOYS

Ferro-manganese: Sales of carload and small lots are still reported as constituting present demand, some of it being British alloy at $58.35, seaboard. The American alloy is sold on the same basis except that of the Carnegie Steel Co. at $60, Pittsburgh.

Spiegeleisen: There have been sales of small lots of the 20% alloy at $26, furnace, and of the 16 to 19% grade at $25, furnace, but demand is not broad.

Ferro-tungsten: Demand is absent and quotations are unchanged and nominal at 40 to 45c. per pound of contained tungsten, with the foreign product at 50c., duty paid, f.o.b. Atlantic ports.

Ferro-silicon: Demand is confined to sales of small lots at $55 to $60, delivered, depending on the quantity, delivery, and consuming point. Active negotiations are on for contracts for 1922 consumption which may develop into certainties any day.

Ferro-chromium: There is no demand and quotations are nominal at 13 to 14c. per pound of contained chromium, delivered, depending on the carbon content and other stipulations.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb.	1.00 to 1.50
“ “ “ “ “ carboys “	2.00 to 2.75
“ “ C. P., 9-lb. bottles, in barrels, per pound	0.23½
“ “ “ bulk, in carboys, per pound	0.18½
“ muriatic, com'l, in carboys, per 100 lb.	2.25 to 3.25
“ “ C. P., 6-lb. bottles, in barrels, per pound	0.28½
“ “ “ bulk, in carboys, per pound	0.22½
“ nitric, com'l, in carboys, per 100 lb.	7.25 to 8.25
“ “ C. P., 7-lb. bottles, in barrels, per pound	0.38
“ “ “ bulk, in carboys, per pound	0.27¾
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb.	5.25 to 6.00
“ powdered, in barrels “	5.50 to 6.50
“ glass, ground, 30 mesh, cases, tin lined, per 100 lb.	16.50 to 17.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb.	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	27 to 37
Lead acetate, brown, broken casks, per 100 lb.	16.00
“ “ white “ “ “	19.00
“ “ “ crystals, per pound	0.20
“ C. P., test., granulated, per 100 lb.	17.50
“ “ sheet, per 100 lb.	14.50
Litharge, C. P., silver-free, per 100 lb.	15.50
“ com'l, per 100 lb.	12.50
Manganese oxide, bulk, imported in barrels, per lb.	0.08¾
Manganese di-oxide, bulk, Caucasian (85% MnO_2, – ¾% Fe), in casks, per ton	60.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.14½
“ “ “ “ granular “ “	0.15
“ “ “ “ powdered “ “	0.17½
“ carbonate, calcined, in barrel lots, per lb.	0.09 to 0.12
“ permanganate, in drums, per pound	0.40
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in sacks, per 100 lb.	2.50 to 3.00
“ “ “ in barrels “	3.00 to 3.50
“ bicarbonate of “ “	2.75 to 3.50
“ caustic, ground, 98% “ “	5.25 to 6.00
“ “ solid “ “ “	4.30 to 4.75

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft.	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	375.00
Conduit, galvanized iron, ¾-in., per 100 ft.	10.00
“ “ “ 2-in. “	31.45
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb.	18.70
“ “ “ 10, triple-braid, weather-proof, coil lots, per 100 lb.	21.50
“ “ “ 14, single-braid, rubber-covered “ per 1000 ft.	7.90
Insulators, glass for telephone, No. 9 pony, per 1000	55.00
“ “ power, No. 14, per 1000	68.30
“ porcelain, 6600 v., No. 44, per 100	19.30
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
“ “ “ “ solid, per 1000	20.20
“ “ “ 3½ “ “	69.20
“ tubes, 5/16 by 3-in. “	9.05
“ “ ½ “ 6-in. “	38.15
Sockets, weather-proof, molded, No. 60,666, per 100	27.60
Telephone wire, iron, size 12, half-mile lots, per 100 lb.	8.75

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	14.11
“ “ electric, 6-ft., No. 6, in lots of 1000, per box of 100	6.46
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb.	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb.	19.00
“ gelatine “ “ “	19.00
“ ammonia “ “ “	18.00
Fuse, common, in case lots, per 1000 ft.	7.22
“ waterproof, triple tape, in case lots, per 1000 ft.	9.01

FUELS

Coal, Utah steam, $3.50 at mine, plus $7.25 freight to California terminal points, in carload lots, per ton	10.75
Coal, blacksmith's, in carload lots, per ton	21.00
“ “ in small lots, per ton	24.00
Coke, in carload lots, per ton	25.00
Fuel oil, per barrel	1.50
Diesel oil, per gallon	0.06
Distillate “ “	0.16½
Gasoline “ “	0.22½

HARDWARE

Anti-friction metal, per pound	0.16
Babbitt, genuine “	0.42½
Brass sheets, half-hard and soft, per pound	0.24½
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
“ solid “ “ “	0.11
Fish-plate bolts, ⅝ by 2-in., per 100 lb.	7.90
Nails and spikes (20d to 60d base), per keg	4.00
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb.	9.45
“ cold punched “ “	11.25
Picks, mining, 5-lb., per dozen	11.25
Shovels, carbon steel, No. 2, long handles, per dozen	15.00
Track spikes, ⅝ by 4-in., per 100 lb.	4.65

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb.	3.25
Rails, steel, 16-lb., per 100 lb.	3.69
Reinforcing-steel, per 100 lb.	3.25
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb.	6.25
“ flat “ “ “ “	6.15
“ flat, black iron “ “	5.50
Structural T's, channels, angles, and beams “	3.25

A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.

Bars, steel, square, cold-rolled, per 100 lb.	6.00
Pipe, wronght-iron, black, standard, 1½-in., per 100 ft.	11.25
“ “ galvanized “ “ “	14.70
“ “ black “ 4-in. “	48.05
“ “ “ extra strong “ “	95.25
Shafting, cold-rolled (2¼ to 3-in. base) “	4.90

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 27½%; extra strong cast-steel, 35%; plow-steel, 40%: blue-centre steel, 25%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue centre rope, per foot	0.375
Cast-steel rope, per foot	0.225
“ “ extra strong, per foot	0.240
Plow-steel rope, per foot	0.258

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	75.00
Fir, common, base price, per M	28.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	34.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	45.00 and 50.00
“ clear, 1 to 2 in. thick, up to 12 in. wide, per M	90.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	80 00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M	200.00
White pine “ “ “ “	150.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, extra hard, 10-case lots, per case	6.30
Carbide, in 100-lb. cans, per can	7.35
Cotton waste, best grade, per 100 lb.	14.50
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.17
“ “ “ 2 (standard), per pound	0.16
Packing, flax, per pound	0.33 to 0.85
“ sheet “	0.25 to 1.00
“ steam or water, first grade, per pound	0.90
Silex lining, crated, per long ton	45.00
Tube-mill pebbles, Danish, selected (in bags), per long ton	25.00
Zinc-dust, in 250-lb. boxes, per 100 lb.	9.50
“ sheet, 36 in. by 84 in., No. 9 gauge, in ton lots, per 100 lb.	13.50

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000, in carload lots, Livermore Star Brand	55.75
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb.	2.65
Portland cement, in bags, per barrel of 380 lb.	3.65

Allowance of 15c. for bags returned in good condition.

Portland cement, in barrels, per barrel of 400 lb.	4.43

A deduction of 50c. per barrel is made on lime and cement when sold in carload lots; 52c. for cement in bags.

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	$25 to $2000
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	10 to 15
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, powdered, per pound	3c. to 6c,
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	20 to 25
Mica, according to size, clearness, and cleavage, per pound	1 to 8
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, ground, commercial, per ton	24 to 26
Tin ore, not less than 60% Sn, per % Sn	4 to 6
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

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EDITORIAL

T. A. RICKARD, ... Editor

DETAILS of a series of experiments in the cyanidation of flotation concentrate are given by Mr. Paul T. Bruhl in this issue. Mr. Bruhl is now in charge of the mill belonging to the New York & Honduras Rosario Mining Company at San Juancito in Honduras. Formerly he was in Nevada. He is a technician especially well qualified to discuss the more difficult phases of cyanidation and flotation. We believe that the details he gives will be appreciated by many of our readers.

BRICK constitutes an important item of construction at a mine, so we are glad to publish the article on the making of brick in a remote mining district. The author is Mr. Harold C. Robson, who was in charge of the smelter at the Spassky copper mine in Siberia, before war and revolution joined to kill peaceful industry in that part, as in other parts, of the world. He gives drawings and detailed figures for the erection of the kilns in which lime is calcined and clay burned for the purpose of making brick, both ordinary and metallurgic. The information he gives should prove helpful to many; we hope they will reciprocate by detailing some of their own useful work.

THE recent disaster at Washington, by which nearly 100 persons were killed by the collapse of a roof that had become laden with snow, was immediately adopted as a suggestion for propaganda by the American Association of Engineers, which now proclaims that "since no other large roofs in Washington failed from this cause, the disaster was evidently due to either faulty design or construction, which would not have existed had licensed engineers or architects supervised the work". Whatever the merits of licensing, the Association's arguments are unconvincing. Any engineer, whether licensed or not, is likely to take chances or make mistakes. His ability to avoid either is due to something that cannot be measured by an examining board that issues licenses.

ON another page of this issue we publish a note on the domestic production of quicksilver during 1921, from which it will be seen that a new low limit was reached of 6339 flasks as compared with 7723 flasks recovered in 1850, when production was first recorded. Greater economy in the use of quicksilver in amalgamation plants, and the spread of a belief that other methods are preferable for the recovery of the bulk of the gold in a free-milling ore, may account for the fact that demand is not greater than it is. Other than in connection with explosives, no new uses for quicksilver have been discovered of late. Amalgamation practice has not received the intensive study that has been accorded to more up-to-date methods of recovering gold from ores. It has been discarded too often because of the danger of theft; this is a reflection on both engineering and economics.

ON February 1 the Star case was decided by Judge W. A. Huneke of Spokane in favor of the Hecla and Bunker Hill companies, their joint agreement to purchase the Star mine being declared valid, as against the contention of sundry shareholders acting in behalf of the Federal Mining & Smelting Company, as explained in our issue of December 24. The correctness of that explanation is fully confirmed by the decision of the Court, which says: "I have an abiding conviction that this contract is valid, legal, and altogether commendable. It is clear to me that the Hecla and Bunker Hill companies have the right to embark in this enterprise [the exploitation of the Star property] and that the contract does not call for any illegal partnership". The result of the lawsuit will gratify the people of the Coeur d'Alene. Details will be found in our news columns.

CONTRIBUTIONS to 'Discussion' this week start with a letter from our friend Mr. Ernest Gayford, of Salt Lake City. He makes some pertinent remarks on the editorial we published recently by way of reply to a reader who wanted to know the cost of a small flotation plant. Mr. Gayford, however, appears to overlook the fact that we had in mind more particularly the needs of a man who had some rich ore, but who had little money as working capital, and who therefore desired to erect a plant entailing primarily a small first cost rather than one economical to operate or efficient metallurgically. The purchase of sundry parts of the equipment recommended by Mr. Gayford might be deferred, under such circumstances, until the time when the enterprise was firmly on its feet. Nevertheless the information given by him is valuable and will be appreciated by others a little better circumstanced that our enquirer in Mexico. In the second letter Mr. F. H. Mason discusses the use of fuel-oil in British Columbia, with a view, among other things, of disciplining the coal producers, who, he insists, demand excessive prices for their product. Mr. Leon A. Perret returns to the charge, and replies to sundry criticisms offered by Mr. A. C. Ludlum of New York. Next Professor Weeks and our Mr. Parsons discuss and defend the definition of 'engineering' put forward by the latter. They write in rebuttal of Mr. P. B. McDonald, who has decided views of his own, and views with which in some respects we agree. It is true that the average engineer as a professional man does his work chiefly for the love of doing it well; he is an artist. That is his first thought—to accomplish the purpose effectively; after that comes enlightened self-interest—the thought of making money by the exercise of his talent. However, *tot homines, quot sententiæ.*

FIAT MONEY, or paper-currency made legal tender by law, with no promise of redemption or backing in specie, is recommended by Mr. Henry Ford to ameliorate the ills that afflict our economic system. The arguments against such a proposal have been stated so succinctly by Mr. Charles E. Mitchell, the president of the National City Bank of New York, that they are worth repeating. After an expression of surprise that two great leaders of industry—for Mr. Ford is supported by Mr. Thomas A. Edison in his views on this matter—are in favor of fiat money at the present time, he admits that the attention given to the subject indicates a popular viewpoint in some quarters that calls for corrective reasoning. There is an air of hocus-pocus about the unrestricted operation of government printing-presses that should put men on their guard, he says; it must be realized that governments are not creators of wealth but have to be supported by taxation. There is an inherent absurdity, he adds, in the idea that a government that has to take up a collection to maintain itself may carry on important industrial work by printing money. He argues that when Europe is weltering in a flood of paper currency, and when all the evils that have characterized past financial history are again being described in the foreign-news columns of the daily press, it seems stupid that anyone in the United States should be discussing seriously a revival of the fiat heresy. The chief obstacle to the rehabilitation of trade today is the fact that the world has mislaid the gold standard. The doctrine of fiat money, of unredeemable paper-currency, has been discredited by every test. It is destructive of stability in the commercial world; it converts legitimate business into speculation, the wage-earner being the principal victim.

THE high cost of shutting-down has earned a place among the high costs of doing sundry other things with which all of us are familiar; evidence of this is contained in the recent report of the Anaconda Copper company for the first nine months of last year. Although the Anaconda company is one of the few that prefer not to take stockholders too much into their confidence as to the details of operations and finance, the report reveals the fact that the operating deficit for the nine months was $1,472,973, while the net deficit after paying $2,381,596 as interest on outstanding bonds was $8,656,557. During the first three months the company produced 30,000,000 pounds of copper, but on April 1 production ceased; it is accordingly reasonable to presume that by far the larger proportion of the loss occurred during the succeeding six months. The Anaconda company has so many diversified interests that the net deficit is difficult to analyze; but it is probable that the cost of maintaining its mines and mining equipment at Butte, its concentrator and smelter at Anaconda, and its various plants at Great Falls is nearer a million than half a million dollars per month. At the same time it should not be inferred that the company has had no return from the outlay simply because no copper has been produced. The mines are doubtless in much better condition for economical production than they were a year ago. For instance, we understand that a great deal of work has been done toward improving ventilation and toward diminishing the fire hazard. Members of the engineering staff have been retained on the payroll, and they have not been idle; they know more about the mines than they ever did before, and more efficient mining in the future should result. The same thing applies to the metallurgical departments. Research has been the order of the day, and the outcome should be the saving in sundry departments of fractions of cents on each pound of metal produced—and fractions added together make units. The past year has been far from satisfactory to the shareholders of copper-mining companies; the shut-down has been costly, but an optimist who is really looking for a ray of light amid the gloom will say that the respite has not been without its advantages from a technical and engineering standpoint; and it is by no means impossible that some dividends will be larger in the future than they might have been had there been no shut-down.

War Minerals Relief

We have received many requests for copies of our issue of March 9, 1918, because it contained an editorial paragraph quoting the late Franklin K. Lane's plea for the extensive production of war minerals. Mr. Lane, in his capacity as Secretary of the Interior, spoke in behalf of the Government; and we have reason to believe that our transmission of his message to the miners had the effect he desired, namely, to stimulate the search for, and the exploitation of, the minerals that the country needed at that critical period. Copies of the issue of March 9, 1918, have been exhausted for some time, so we quote the editorial paragraph mentioned:

"Energetic exploration and intensive development of certain needed mineral resources is earnestly recommended in a circular just issued by Mr. Franklin K. Lane, Secretary of the Interior, entitled 'How to Save Ships'. The purpose in view is revealed by that caption; ships are too urgently required for transporting troops and supplies to Europe to admit of dependence upon foreign sources for such metals and minerals as can be obtained in this country. Mr. Lane points out that their importation not only diverts shipping from the trans-Atlantic service, but produces a further demand for fuel and mining equipment abroad. The minerals specified are manganese, flake graphite, tin, tungsten, antimony, pyrite, magnesite, potash, and nitrates. A proposal has been made, and has received official endorsement, for extending Government aid in the exploitation of such deposits, but it has not yet become law. Meanwhile, the remunerative prices obtainable for these products should encourage a prompt response, quite apart from the patriotic incentive that should bestir every true American to do all that he can.''

Oil on Troubled Waters

In the exploitation of the earth's mineral resources, more especially those in the backward countries of the world, it is highly desirable that an 'open door' policy be accepted and supported by the governments of the Great Powers. Friction and quarrel are to be avoided in the interest of all concerned, for the risk inherent in mineral development is sufficient for speculative purposes without introducing the sinister influence of political competition and national self-assertiveness. We are glad therefore to note that the struggle for the domination of the Persian oilfields is likely to end. It appears that the American and British oil companies operating in Northern Persia are about to settle their differences. The two principal companies, the Anglo-Persian and the Standard Oil, have decided to drop their rivalries and to co-operate, this action following the recognition of their common danger if they persisted in coming into conflict with the political forces representing the Persian, Russian, British, and American governments. The original concessions were obtained from the Persians by a Georgian named Khostaria, who sold them to the Anglo-Persian company; on account of his Georgian birth the Russians claimed him as a citizen; moreover the Russian government claimed the oil territory as being a part of Persia that was within its sphere of influence. The Persian government later repudiated the rights acquired by Khostaria, whereupon the Standard Oil Company negotiated to acquire them. Had this American corporation succeeded in this respect it would have been without means of piping its oil to the coast, on the Persian Gulf. To have continued the fight with the Anglo-Persian company would have involved entanglements with the bureaucrats at Teheran, Moscow, London, and Washington; so the two oil companies agreed to shake hands and work together. The American company will be able to use the pipe-line to the Persian Gulf and the Anglo-Persian company will be saved from interference from Russia, for the Soviet government has withdrawn its opposition. Meanwhile Anglo-American goodwill will be furthered. That is worth the price of many million barrels of oil, at least. The world needs the oil and it needs even more the hearty co-operation of the English-speaking peoples, for in their amity lies the hope of establishing peace and of restoring productive industry.

Mining on the Rand

Last year the mines of the Witwatersrand--the premier goldfield of the world—produced 8,114,586 ounces of fine gold, the normal value of which was £34,489,489, whereas the 'declared' value (that is, plus the 'premium') was £42,588,502. We give the amount in pounds sterling because dollar exchange varies from day to day. The value of the output in paper pounds was £544,621 less than in 1920, but the normal value, that is, omitting the 'premium', was £4,591,672 less than in 1916, when the output was 9,296,618 ounces, worth £39,489,522. The total production of the Transvaal, from 1884 to date, has been 163,249,460 ounces, valued at £710,058,291. To the shareholder the only thing that counts is the dividend; these amounted to £7,250,000 last year, as against £8,300,000 in 1920. In both years the dividends were slightly in excess of the so-called premium. Last year the difference between the British sovereign and the paper pound gave the mining companies a sum of £8,099,013; in 1920 this premium was £8,489,223. Thus it appears that if the pound sterling should go back to parity the profits of the mining companies would be wiped out. The recent rise in sterling exchange menaces the prosperity of the Rand most seriously, for the currency price of gold on the London market has dropped from 127 shillings in February 1920 to 95 shillings this week, the drop being enough to remind those interested of the warning given last November by General Smuts as to what might happen if the gold premium were to disappear "at one swoop". At that time the precious metal was quoted at 104 shillings. It is something more than curious, it is economically damnable that the white workers on the Rand should choose this very time for a general strike. According to 'The Financial Times', the white miners alone received over £9,000,000 in wages during 1920 and the Government of South Africa drew over £5,000,000 in direct taxation from the mining companies. It looks as if the Government and Labor were determined to kill the goose that has laid golden eggs for them so long; and yet that contention would be unfair to General Smuts, who realizes the seriousness of the position and shows an earnest desire to protect the gold-mining industry, which is the mainstay of South Africa. Again the 'color bar' is to the front, that is, the question of removing restrictions that prevent the Kaffirs from doing work now done only by the white workers, at a much higher cost, of course. The latter protest, as might be expected. Representatives of the Mine Workers Union called recently upon General Smuts and Mr. Malan, the Minister of Mines, with a view to discussing a proposed amendment of the regulations, whereby the shift of the native laborer would be lengthened. At present the Kaffirs work for five hours only, whereas the whites work for eight, and much time is lost by reason of a regulation calling for the previous inspection by a white boss of every place underground at which Kaffirs are set to work. The Prime Minister advised a modification of this restriction but he was unwilling to sanction the removal of the 'color bar', recognizing the fact, probably, that to do that would raise a question too dangerous to the social welfare of South Africa as a whole. Native labor on the Rand has increased 12% and its efficiency has decreased 13% since 1914. In his speech on the occasion mentioned, General Smuts stated that of the 39 mines now active, 24 would be shut-down if the premium were to disappear entirely; if the price of gold in London were to drop to 100 shillings, five mines would have to close down; if it fell to 95 shillings, five more could not be operated profitably. The cessation of pumping at some of these mines, notably the East Rand Proprietary group, would compel many others to stop work. In short, the economic status of the Rand depends, according to General Smuts, upon the depreciation of the paper pound, the consequence of the war debt of Great Britain to the United States; if the debt were to be cancelled, exchange would be restored, gold would sell for 85 shillings in London, and the 'premium' would be a thing of the past. Therefore, General Smuts adds: "We know that unless we are prepared to incur the gravest risks in regard to the future of this industry, we ought to see, and start early to see, that we are not dependent merely on the gold premium, but that our industry is on such a basis that it can continue to run on for the future whatever happens to the gold premium". The Rand district has the largest population of any industrial centre in South Africa; the country is not yet developed sufficiently to absorb the large number of people that would be thrown out of employment by the closing down of 24 mines on the Rand. General Smuts concluded his speech in the following words: "I do not think we should continue to exist by favor of the gold premium or of America. I do not think our industry should continue on a mere fortunate accident like that, but we should put our house in order, and we have the power to do so, if we make proper use of the native labor that we have here at present". Obviously, the Rand managers ought to have learned long ago to make larger use of the supply of indigenous labor, and train it, so as not to be compelled to depend upon imported white labor, which is expensive and aggressive.

Licensing of Engineers

One of the most important functions of a professional organization is to elicit the opinions of individual members, with a view to the formulation of a corporate decision on the important questions of the day. The Mining & Metallurgical Society of America is performing useful work in this connection. The results of its activities indicate that progress, one phase of which is the development of a healthy public opinion, can result from unostentatious effort and the development of the co-operative spirit. When the subject of the licensing of mining engineers was mooted some time ago a committeee was appointed to study the matter. Questionnaires were sent to members, with the result that the Society is now in a position to issue an authoritative expression of opinion, based on the views of the majority, who oppose licensing in any form. A few members are in favor, conditionally; a large number are in favor of unconditional licensing, basing their attitude on a desire for a higher professional standing for mining engineers and the better protection of the public. Those in favor but conditionally may be considered as a section of the opposition, in view of the weight of negative opinion they have expressed that bears on the conditions stipulated. A summary of conclusions indicates that the concensus of opinion against licensing is due to the conviction, primarily, that such a system of legal classification would neither improve nor safeguard professional standing, partly because professional qualifications could not be formulated adequately in any law that might be framed for the purpose, and partly because of probable miscarriage in its administration. In determining professional qualifications it is necessary to take into account not only the technical ability needed but also character and lay attributes. Technical ability is often of secondary importance; the matter of qualifications is a question of something inherent or earnest, rather than of something required; it is something that no conveivable licensing system could measure. The administration of such a law not only would be difficult on this account but in all probability it would suffer from the influence of politics as well as from undue regard for local interests. In consequence, it is held that licensing would be of no real advantage to the profession; it would involve useless expense and hardship; it could not be made to ensure the exclusion of the unfit. Some members are of the opinion that licensing would favor the unfit, thereby tending to lower the standing of reputable members of the profession. The maintenance of professional standards is regarded essentially as a professional matter, although it is recognized that a strong incentive to excellence is provided as a result of the discernment of employers and clients. The position of the public in relation to licensing must be discussed from the standpoint of the employers as well as from the standpoint of the investors. Whether managers of mines should share responsibility and be required to qualify for a license by examination, as in South Africa, is not considered; it may be observed that, even there, licensing does not extend to consulting engineers. Investors are believed to be as well protected as is possible, and more likely to suffer than to benefit as a result of the adoption of licensing. Their position is different from that of the general public, for their transactions are not of such urgency as to preclude inquiry and verification, the means of which are ample. Licensing would not relieve them of the need for the exercise of precaution, because it would not remove the unfit from the profession or prevent such from being licensed; it might, in some instances, give rise to a false sense of security, thus obscuring the need for precaution. The committee recommends that the Society should not actively oppose the licensing of mining engineers, but should stand ready to co-operate with other interested bodies to that end if and when joint action appears to be desirable. So far as we are concerned, it would seem that the subject ought to receive its quietus.

Cost of a Small Flotation Plant

The Editor:

Sir—I have read with a good deal of interest your editorial on this subject in your issue of January 14, and having had occasion in the last few years to estimate the cost of a number of these small plants, the figures given in your article are I am sure of great public interest.

I note you cite the case of a 60-ton flotation plant costing $42,000 complete, including all buildings, etc., or a cost of $700 per ton of daily capacity. By a rather curious coincidence the cost of the 60-ton plant cited by you is exactly the same per ton of daily capacity as the 130-ton plant mentioned in the same article, which cost $91,000, and very close to the same cost per ton of daily capacity of the 200-ton plant that cost $135,000. My experience has been—and I think that all those familiar with this class of work will have found the same thing—that the smaller the capacity of the plant the higher the cost per ton of capacity, therefore it is unusual to find that a 60-ton plant, a 130-ton plant, and a 200-ton plant cost approximately the same per ton of capacity. I also note that you state that it is reasonable to say that $30,000 ought to build a workable plant of 50-ton capacity. This figures at $600 per ton of daily capacity, or less than the 60-ton, the 130-ton, or the 200-ton plants mentioned in the same article, and seems to be in inverse ratio.

To satisfy myself about what a 25-ton flotation plant should cost, I drew up a flow-sheet, took off my machinery list, and used empirical figures for the cost of freight, hauling, buildings, foundations, etc., assuming the following:

That the crushing was to be to 65-mesh.

That fairly adequate storage for crude ore and crushed ore should be provided.

That the flotation tailing was to be tabled, and the flotation concentrate thickened, filtered, and dried.

That electric power was available.

That the ratio of concentration was approximately 6 : 1.

The coarse-crushing part of this plant, which would operate 8 hours, consists of a crusher, a set of rolls, an elevator and screen, and is supposed to reduce the run-of-mine to minus ⅜ inch. The grinding and treatment plant consisted of a ball-mill, classifier, rougher and cleaner flotation machines, concentrating table, thickener, filter with vacuum-pump and receiver, and the drying was done on steam-coils. The motors would be a 25-hp. motor for the crushing department, and 20-, 10-, and 5-hp. motors for the grinding and treatment departments. The factory cost of the principal machinery amounted to $12,532. Taking certain empirical figures based on the cost of the principal machinery—which my experience tells us are approximately correct—the transmission belting and piping amounted to $1700, making a total cost for the equipment of $14,232.

Under pre-war conditions actual construction has shown us that for every $1 of cost of machinery f.o.b. factory $1 must be added for the cost of the mill complete with machinery in place and ready to run. This would make the total cost of the 25-ton plant $28,464, or $1139 per ton of daily capacity.

Under war conditions it was found necessary to add $1.50 for each dollar's worth of machinery at the factory in order to get at the cost of the mill complete. This would bring the cost of the 25-ton plant to $35,580, or $1423 per ton of daily capacity.

The present-day cost would probably be in between these two figures.

The principal cost in a flotation plant of this size is in the fine-grinding department. It is unusual to find an ore that will respond to flotation at less than 65-mesh crushing, although some plants are operating at 48-mesh. This would not, however, make a serious difference.

The fine-crushing calls for a mill that is expensive as compared to its capacity, and a high consumption of power per ton of ore crushed.

Reviewing these figures, I feel doubtful whether it would be safe to estimate that a 50-ton flotation plant complete, with all the necessary equipment but without unnecessary refinement, could be built for $30,000; in fact, I should consider it safer to figure from $45,000 to $50,000.

ERNEST GAYFORD.

Salt Lake City, January 19.

Fuel in British Columbia

The Editor:

Sir—In his article on 'Mining in British Columbia in 1921', which appeared in your issue of January 7, I venture to think that Mr. Mortimer-Lamb expresses the opinion of only a small proportion of the people of British Columbia and of Canada when he advocates an increased duty on fuel-oil, in order to protect the coal-mining industry of Vancouver island. Everyone will agree with Mr. Mortimer-Lamb as to the wisdom of patronizing home industries, always provided, however, that the home industries are playing a fair game. Are they doing that in this particular instance?

Formerly it was the custom for the coal-mine operators to render a statement to the Government, giving, among other things, the average rate of wage paid to each class of employee, and this statement was published in the annual report of the Minister of Mines. During recent years several of the big operators have failed to supply this information, or, at any rate, it has not been published in the report, the reason presumably being that they do not care to let the public know the wage-rate that they are paying. A few companies still supply the information. I take the following figures from the Granby company's statement of the average wages paid at its Cassidy colliery in 1920: miners, $8.61; underground laborers, $5.82; surface laborers, $5.24; mechanics, $6.24. One operator quotes miners' wages as ranging from $7 to $12, and I have been informed that as much as $15 per day has been paid. There has been a slight reduction in the wage-scale since 1920, but, I understand, not a marked one. From one-fourth to one-third of the employees at the collieries are Asiatics, and these, I believe, get a smaller wage. So much for the price of labor. The retail price of lump coal at Victoria and Vancouver since the Armistice until within the last few weeks has ranged between $13.50 and $16. During the last year competition against fuel-oil gradually brought the price down to the lower figure. Quite recently a drop of $2 was made in a day, and now lump coal is selling at $11.50. Why the sudden drop? Because, despite a freight-rate of $4 to $4.25 per ton, against about 60 cents from Vancouver Island collieries, the Alberta mine-operators were underselling the Island producers in the Vancouver and Victoria markets.

The miners may be justified in getting all they can for their labor and the operators all they can for their coal, but surely it would not be justice to tax the whole fuel-consuming community in order to maintain the present high prices of fuel and labor at the Vancouver Island collieries; this I believe to be the predominating opinion throughout the Province and the Dominion.

Victoria, B. C., January 16. F. H. MASON.

Russian Placer Mining

The Editor:

Sir—In your issue of June 11, Mr. A. C. Ludlum points to the serious error I made in typewriting my first article, published in your issue of March 19, 1921. I feel guilty of unpardonable negligence, but in the particular instance referred to this error is of no special importance, as it was the approximate relative, and not the absolute, fuel consumption that I wished to emphasize. The average for the electric dredge being 3500 cords per season, it must be concluded that there were operating seasons when the fuel consumption exceeded this average, and it is most likely that this was the case during the 218 effective days in 1915. Thus, exclusive of the one fatal naught that I added, Mr. Ludlum's statement regarding the fuel consumption on the Kolchan electric dredge only confirms my conclusions.

It is beyond contradiction that owing to the transformation of the driving-power twice, and the inevitable loss in the line, the direct use of steam on board a steam-driven dredge requires a considerably smaller fuel consumption than an electric one driven by a steam-generating power-plant, especially when the latter supplies one dredge only, as at Kolchan. Moreover, in such a case a steam-driven dredge is also more economical in regard to labor than an electric one, because the latter, besides the labor necessary for running the steam-plant, which is the same as on a steam-driven dredge, requires a squad of skilled electricians, and the services of an electrical engineer. When two, or more, dredges are driven from a central power-plant these surplus items are divided among the number of units, and in such case, both the cost of fuel and labor on an electric dredge may be less than on one that is steam-driven. This is all rudimentary knowledge such as may be found in every handbook on the subject. Each type, electric- and steam-driven, has a certain sum of inherent advantages, and the only proper way to decide which is the right one to select is to consider in each individual case, according to the local conditions prevailing, which of these two totals of advantages outweighs the other. Any other way of solving the question leads to routine, the mother of regress.

In my article I had no intention whatever of deprecating electric dredges; I only pointed out the inadequacy of installing an electric generating plant for supplying one dredge only, and to erect it a great distance away, when fuel is plentiful close to the working areas, which by all means have to be cleared of timber.

Mr. Ludlum advances a rather curious argument in favor of electric dredges in general in comparing the Kolchan dredge with the Demidoff, that is, the dredges of the Compagnie Anonyme de Platine working on the Demidoff (Nijne Tagil) estate. He ascribes the greater yardage of the former to the use of electricity as driving power. The yardage of a dredge is in direct relation to the amount of driving power applied, but I fail to comprehend how the digging performance of a dredge has to do with the mode of generation of this power. Besides, the comparison is unfortunately chosen, because, first, the Demidoff dredges worked platinum placers, which, being formed by disintegration of rocks of the olivine group, present a far heavier, tougher, and more sticky ground than the Kolchan alluvium, which among the Russian placer deposits must be classified as easy-digging ground, and, second, the Demidoff dredges are, all six of them, open-connected bucket-line dredges (made by Arthur Brown, London), the yardage of which, the buckets being of equal capacity in both instances, is, obviously, less than that of the close-connected Kolchan dredge in proportion to the ratio of the number of buckets. This ratio is generally close to one-half; consequently the yardage of the Kolchan dredge ought to be compared with the amount of gravel handled by two Demidoff dredges during the same period, and this would be $\frac{376{,}200 \times 218 \times 2}{256}$ = 640,715 cu. yd., or 19% more than the Kolchan dredge. Thus the excess yardage of 75% of the latter against one Demidoff dredge does in no way illustrate the superiority of electricity as driving power on the Kolchan dredge, especially if we take into account the much heavier ground the Demidoff dredges had to dig.

As for the rest, the comparison between the close-connected Kolchan dredge and the open-connected Demidoff transfers the question to an entirely other plane. This question, I well remember, was discussed some ten years ago in 'The Mining Magazine', and it would serve no practical purpose to start the discussion again. In my article I explained the reasons why the New Zealand type of dredge has the preference in Siberia, and these reasons seem palpable enough. A glance at Fig. 6 and 9, illustrating Frank A. Stanley's interesting article in your issue of October 22, will convince anybody having practical knowledge of the means of communication to Siberian far-off mines of the impossibility, save in exceptional cases, of transporting such machinery.

As for the gold produced by the Kolchan dredge, that cannot serve as a criterion of efficiency in the operations. I have no information as to the profit made by the Demidoff dredges, but it is likely that it was higher than that of the Kolchan, in view of the fact that in 1915 the price of platinum was approximately eight times that of gold.

My remark on page 392 of your issue of March 19, 1921, concerning the unprofitableness of the Kolchan placer enterprise alluded to the period previous to 1915 and the operation of the drag-line excavator (stacker-scow), although during the two preceding years the dredges appear to have yielded no profit by themselves, quite independently of the unfortunate operations on the Ural lode property, and Mr. Ludlum indicates the profitableness of dredging on the Kolchan mines beginning from the above-mentioned year, only. The stacker-scow is an appliance that can be used successfully in appropriate cases, but on the Kolchan mines it proved inadequate, and I mentioned it in connection with the factors that, in my opinion, led to the wholesale failure of foreign placer-mining enterprises in Russia. I may have been mistaken in the number of unsuccessful operating seasons, but the failure of the drag-line excavator at Kolchan is a fact that I anticipated, as stated on page 690, Vol. XXI of the Transactions of the Institution of Mining and Metallurgy for 1912.

The drag-line excavator is an American invention, I believe, whereas dredging is not an American method, bucket-dredges being a Dutch invention originated for the construction of the 'polders' of Holland, and applied to gold-placer mining primarily in New Zealand, whence it was transplanted to America, even later than to Russia. In 1892 I had the opportunity to see the prototype of the modern dredge, the current-wheel dredges on the Clutha river (New Zealand) where there were seven or eight of them working. The driving power was generated by the current of the river by means of two undershot-wheels similar to the paddle-wheels of a steamer. America is to be credited with the improvement in dredging machinery, and I readily believe Mr. Ludlum has contributed his share in this direction, but dredging is not an American method. I did not attack American methods. This is a misinterpretation of the sense of my articles, in which I did not make a case against American methods, but pointed out the danger of disregarding Russian ones.

Yokohama, December 15, 1921. L. A. Perret.

A Definition of Engineering

The Editor:

Sir—I was interested in the de''cuss''ation that Mr. McDonald gave Mr. Parsons' letter on a 'Definition of Engineering'. Since "Mr. Alfred P. Flinn and associates . . . discourage any attempt to define the engineer", of course, such an attempt would be presumptuous. Mr. Parsons carefully avoided the snare by defining not 'engineer', but 'engineering', and his definition seems to me reasonable. This is his definition: "Engineering is the devising of plans and the contriving of means and methods for the creation of something having material value to mankind by the utilization of machines, commodities, human labor, and the forces of nature".

This is the broad conception of engineering and the work may be of such magnitude that, as Mr. Parsons states, many specialists may be engaged in accomplishing different parts. Mr. McDonald takes issue with the idea of an engineer creating things. He says: "On the contrary many of them merely condemn prospects, transport things, tear things down (such as New York skyscrapers that are considered obsolete) or measure things".

Who ever heard of a 'professional condemner'? Such a person might save his client's money, but he certainly would never make any. Of course, prospects are condemned in the search for a mine, but the object of the search is to find and approve, not to condemn. The work of examination is one step toward the creation of a mine.

Those who 'transport things' may or may not be engineers, but they are certainly taking chances. I read recently that a man in Mr. McDonald's town had his pants confiscated by prohibition agents. The conception and putting in operation of a transportation system is certainly an engineering feat.

Destruction or tearing down may be a step toward creation. A forest may be destroyed that a railroad may be built or a useless structure may be removed that an adequate one may be erected. The engineer who tears down is no less an engineer than he who builds, so long as he plays one part in the drama of accomplishment. In the same way those who "measure things" may also be engineers.

Mr. Parsons says that the object of engineering is to create something of material value to mankind. Mr. McDonald says the object of engineering is to make money. Suppose that you saw a man fitting cog-wheels together and you should say, "What are you doing, my good man?" Suppose he should answer, "I am making money for my family". You would think that he was trying to be funny. It is equally absurd to say that the object of engineering is to make money. The purpose of engineering is to construct something that people need. The motive that impels the engineer may be the desire for money or fame, or it may be love, hate, or philanthropy. Whatever be the motive it is not the purpose of engineering.

Finally Mr. McDonald asks the rhetorical question, "So military engineers that design devices and concoct poison for killing people, better humanity?" One is not supposed to answer a rhetorical question, but I cannot help suggesting that it depends upon the discrimination with which the victims are selected.

Berkeley, January 7. WALTER S. WEEKS.

The Editor:

Sir—Mr. P. B. McDonald's comments in your issue of January 14 on the result of my modest effort to define 'engineering' reveals either obtuseness or carelessness. I stated explicitly and specifically that I would not attempt to define 'engineer', but would endeavor to define 'engineering'. Possible the idea expressed in this statement filtered through the interstices of a reticulated or decussated network (I borrow his own words and plead guilty to redundancy) of Mr. McDonald's faculties of perception; certainly the distinction escaped him utterly. I suggested that

"Engineering is the devising of plans and the contriving of means and methods for the creation of something having material value to mankind, by the utilization of machines, commodities, human labor, and the forces of nature."

Mr. McDonald ascribes to me the statement that "engineers create things" and that "engineers toil for humanity's betterment". If he really sees no distinction between the ideas in the definition and the distorted version of them that he offers, it is useless to discuss the question. I assume, however, that he is merely careless. In the remarks accompanying the definition I explained that "the arts comprehended by the term engineering are so diversified that there are hundreds of kinds of engineers", and that, since it was impracticable to enumerate all their activities, I would try to define 'engineering' in terms comprehensive enough to include all. Mr. McDonald avers that I say "engineers create things", whereas some of them only condemn prospects, or transport things, or tear down obsolete scyscrapers, or measure things. Of course they do! Here is an analogy: A farmer in the course of his regular business, may look at a neighboring ten-acre field and decide not to buy it; he may haul his wheat to the railroad siding; he may tear down the old cow-shed to make room for a new one; he may measure the corn in the crib to see how many pigs it will fatten for the fatal trip to Omaha or Chicago; but this does not disprove the fact that farming, essentially, is the production of things for the stocking of the collective larder.

Nor does the truth that most farmers, like most engineers, "toil for money" (I quote Mr. McDonald; and I admit that both do), in any way alter the fact that farming is the production of vegetal and animal commodities for use as human food. Suppose there were no money and no exchange of goods, the raising of corn would have for its obvious purpose the material benefit of human beings, and so, it seems to me, would the mining of copper and the building of a road.

Education has been defined as the systematic development and cultivation of the intellectual and mental faculties of human beings. If he were consistent, Mr. McDonald would say that, since most professors "toil for money", the purpose or object of education is to afford a livelihood for teachers or professors, and that therefore the definition is seriously at fault. Columbia University, an institution that is great because it provides bread and butter for seven hundred professors and instructors! Unless my ideas are distorted, Mr. McDonald's contention is no less absurd.

He injects a question concerning military engineers who "design devices and concoct poisons for killing people". War is abnormal; it is catastrophic; it should be avoided; perhaps, hereafter, it will be avoided. Incidentally, copper and steel are no more indispensable in war than are wheat and sugar and wool and hides, but it is not logical to conclude that commodities produced by agriculturists and stock-raisers cease during war-time to have material value for mankind. The gigantic importance of engineering in normal peace-time industry so far eclipses its part in war that the latter may reasonably be ignored.

In order, however, to avoid the charge of evading the issue, the question can be considered from another angle. Setting aside as being too altruistic the sentiment that once aroused the enthusiasm of most all of us, "to make the world safe for Democracy", this country's ultimate purpose in the recent War was to save itself from possible invasion by a victorious and ruthless enemy; and the munitions it manufactured were distinctly, to quote from the definition, "of material value to mankind", or at least to much the greater part of mankind. Whether or not they served to "better humanity", as Mr. McDonald would have it in his rather 'free' version of my statement, is immaterial. It is true that I invited general criticism; I still offer the definition, either as a repast for "skilful dialecticians" who may be hungry, or to engineers who may have a better one to suggest. I do feel justified, however, in asking that those who find fault, find fault with the definition and not with a fanciful perversion of what it says. The definition has serious faults, but I submit that if Mr. McDonald discerned them he failed to reveal the fact in his criticism.

San Francisco, January 31. A. B. PARSONS.

ELECTRICITY produced at public-utility power-plants in the United States for the year 1920, according to the U. S. Geological Survey, totaled 44,004,000,000 kw-hr. Water-power contributed 16,545,000,000, or 37.6%, and fuel-power, 27,459,000,000, or 62.4%. The increased output over 1919 was 13.1%; the increase for water-power was 13.3%, for fuel-power 12.9%. The fuel used in 1920 was 37,244,000 short tons of coal, 13,123,000 bbl. of fuel-oil, and 24,702,000,000 cu. ft. of gas, with increases over 1919 of 6.1, 18.2, and 15.4%, respectively.

Brick-Making in Remote Mining Districts

By H. C. Robson

INTRODUCTION. Smelting works that are situated far from civilization and have to depend on outside sources for their supply of brick are heavily handicapped; in isolated places the cost of importing might be so great as to be prohibitive. It seemed to me therefore that a few notes on the manufacture of ordinary and refractory brick might be of interest to those who at present depend on the imported article.

The following notes are the result of work done in Siberia, with native labor, at a smelter situated over 500 miles from the rail-head. Material for the manufacture of common building-brick can be obtained usually without difficulty in the vicinity of the works, and, generally speaking, it will be the first material required when constructing a plant or dwellings. Before the actual manufacture of such brick is taken in hand, tests should be made on small quantities of the clays available, using a hand cupel-mold for forming the test-pieces, which can then be burned in an ordinary assay muffle-furnace. The samples when finished should be tested. Methods of performing these tests can be found in any text-book on brick-making.

MAKING BRICK BY HAND. When only small quantities of brick are required, hand-molding is probably the cheapest method of manufacture; but for large numbers the wire-cut type of machine is more satisfactory, being easy to operate, inexpensive in first cost, and requiring a comparatively small amount of power. A machine of this type was in use at our plant for seven years and gave no trouble. Its maximum output was 1000 brick per hour; a 15-hp. electric motor was used for driving it. Most clays are unsuitable for making directly into brick; a mixture of two or more clays or sand will be found necessary to produce a brick that can be dried fairly rapidly without cracking and that will give a good finished product.

Drying-sheds are necessary, as extreme heat, wind, or rain will cause a large number of failures if they are not used. The type of shed we used was of the simplest construction, being a framework of light poles nailed together and covered with a thatch of hay or straw.

The selection of a kiln calls for much thought. The simply constructed open-top type is favored by the beginner, but is more difficult to operate than a circular up-draught kiln, which is recommended for general mining conditions; it is not difficult to construct, it is simpler to operate, and needs less repairs than the open-top variety, especially when skilled labor is not available. Fig. 1 illustrates this type of kiln and is identical with one that we used successfully for years in the burning of building- and fire-brick. The standard Russian brick is $10\frac{1}{2}$ by $5\frac{1}{4}$ by 2 in.; this kiln handled about 15,000 in ten days, including loading and unloading. The percentage of failures during the burning-operation was under 5% when due care was exercised in setting and burning. The loading of brick into a kiln was done with great care. For building-brick, it was found that setting them on edge in herring-bone fashion was the most satisfactory method.

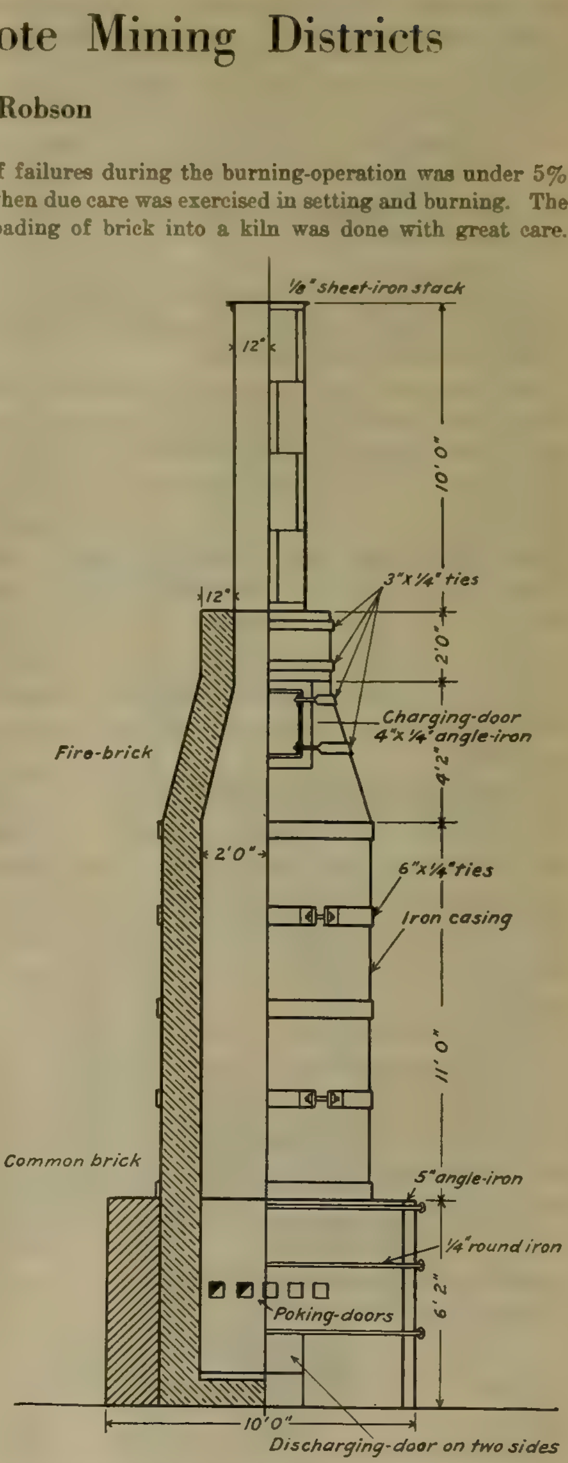

FIG. 2. LIME-KILN AND CLAY CALCINE

It will usually be found that the cheapest and best brick produced by unskilled labor is that made by the simplest process under rigid supervision. The following figures represent the average cost of producing a red brick of good quality for general constructional purposes, the total number made during the period in question being 850,000:

	Per 1000
Supervision, labor, and material	$6.11
Power (for wire-cut machine)	0.52
Coal for burning	2.31
Repairs to machinery	0.46
Repairs to kilns and sheds	0.47
Hay for covering sheds	0.45
Total cost	$10.32

About 1 lb. of coal (containing 18% ash) was used in burning one brick of Russian standard size, or, in other words, 10% fuel to brick, by weight.

MANUFACTURING OF FIRE-BRICK. No. 1 fire-brick was made from a clay that underlay the coal seam in the company's own colliery. This clay was calcined in order to drive out water and carbon dioxide, and to burn small quantities of carbonaceous matter. The furnace originally used for this purpose was an old copper-refining furnace; but, subsequently, a small kiln (Fig. 2) was erected for this purpose. This was less expensive to operate and had a greater capacity. The calcined clay, or 'grog', was ground in a Chilean mill, 5% raw clay being added as a bond with the necessary water to make a stiff paste, which was allowed to stand for 24 hours, so as to temper it before being made into brick of any desired shape.

No. 2 fire-brick was produced from a white clay, which was a product of decomposed rock, found locally but fairly refractory; it was difficult to handle, as the fragility of the green brick accounted for a large number of failures, both in drying and burning. This clay did not require calcining and was therefore inexpensive to make into brick, but could only be used in light structures, as failure occurred under large compression strains.

No. 3 fire-brick was manufactured from a mixture of 85% white clay and 15% uncalcined fire-clay. The mixture was first slimed in the Chilean mill with the necessary water, tempered for 12 hours, and then formed into brick in the wire-cut machine. This brick was of excellent quality, being refractory and mechanically strong, and altogether superior to No. 1 and 2. It was used for boiler-settings, furnace-flues, and fire-boxes, and would stand a temperature under load of 1200°C. The appended analyses represent typical specimens of the two clays used:

	Clay from under coal measure, %	White clay, %
Organic matter and water	11.68	2.51
Silica	62.46	65.20
Alumina	23.04	29.31
Ferric oxide	0.58	1.93
Calcium oxide	trace	1.56

The manufacture of No. 1 and 2 fire-brick was abandoned, owing to the superior quality of No. 3 brick. The cost of production varied with the number made and was 30 to 50 dollars per thousand.

FIRE-CLAY FOR MOLDING. The calcined clay, with 5% raw clay, was ground in the dry state until the coarsest particles were ¼ in. Water was then added gradually while the grinding proceeded, until the mixture was worked into a stiff mass; it was then discharged from the pan and stacked for 24 hours under damp sacking to temper it thoroughly. The molding of No. 1 and 2 brick was done in a simple hand-machine which had a foot-operated plunger for ejecting the brick, as shown in Fig. 4, which gives a general idea of its construction, with measurements.

The method of molding was as follows: a piece of clay was cut by a spade and thrown into the mold, then tamped with a hard-wood mallet to force the stiff clay into the corners of the mold. After this operation was complete, the excess clay was struck off with a strip of iron and the brick forced from the mold by the foot-operated plunger; it was then lifted by two wooden strips on each side of the brick and placed on the racks to dry, the time usually necessary being two days. The final drying was performed on hot plates. After drying for 24 hours on the hot plates the brick was ready for stacking or loading into the kiln.

SETTING OF BRICK IN KILN. The most satisfactory method, which was adopted after many trials of alternative systems, was as follows: The hearth of the kiln was first leveled with crushed silica, the brick being then set in a series of square piers, which were built up by setting three on edge and parallel to one another; the next layer was set at right angles to the previous one, and so on until the pier was built to the required height, a space of ¾ in. being left between bricks and 1 in. between piers. Odd shapes were loaded in the top of the kiln, so as to facilitate setting and to minimize breakages.

BURNING FIRE-BRICK. The kiln used for this purpose was similar in construction to that illustrated in Fig. 1. The first operation of burning was the removal of hygroscopic water, this period varying with the different clays used, but 1½ days was sufficient usually. During this stage the temperature was kept at about 300°C. with an excess of air. To determine when the brick was thoroughly dried, a cold, iron rod was inserted through an inspection-hole in the roof of the kiln; if water was present, it deposited on the rod.

In the second, which immediately follows the above stage and usually termed the oxidation period, the water of combination is expelled and the lower oxides of iron are oxidized further, and the shrinkage of the brick takes place, a temperature of 800°C. being the maximum necessary. A period of vitrification now follows, when the basic oxides combine with the silica and alumina to form a slag or clinker, which binds the particles together, forming a strong and compact brick that gives a metallic ring when struck. The firing of the kiln at this stage was controlled, so that only a small amount of excess air was admitted, the temperature maintained being about 1250°C.; every precaution is taken when stoking to keep this temperature uniform. The progress of the burning-operation was ascertained by measuring the amount of shrinkage that had taken place in the brick, but pyrometer readings at regular intervals are recommended, or, failing this, the use of Seger cones.

At the above-mentioned temperature, about three days sufficed for our particular kind of clay; but the time varies considerably, and can be ascertained only by tests on different clays. On the completion of burning, the ash-pits and fire-boxes were bricked up and the kiln allowed to cool slowly by radiation only. Forced cooling tends to develop cracks which might be small but will cause failure when the bricks are put to use.

The kiln was not opened until it was possible to lift a brick with the naked hand, the time for cooling varying with the temperature of the air surrounding the kiln, but never less than three days, even in the coldest weather.

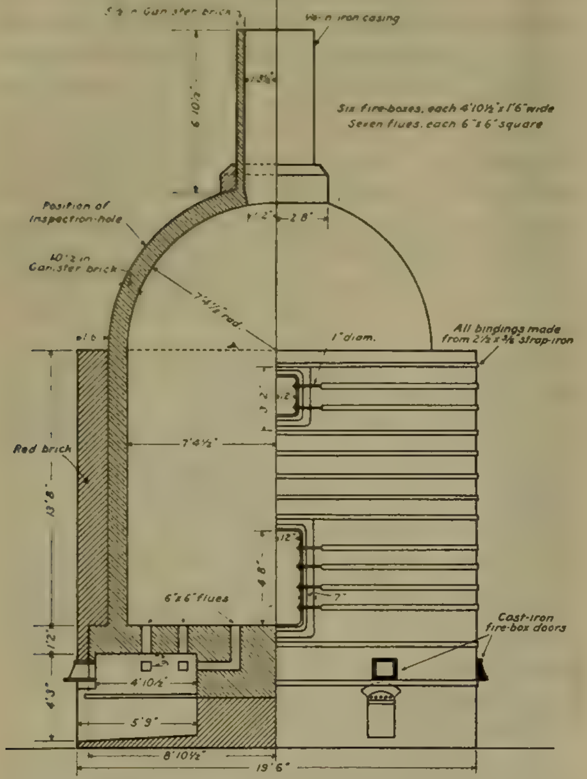

FIG. 1. KILN FOR BURNING COMMON BRICK OR FIRE-BRICK. CAPACITY, 15,000 OF 10¼ BY 5¼ BY 2⅝ INCHES

With a low-grade fuel, about 1.3 lb. coal was consumed per brick burnt or 15% of fuel to brick by weight. The following analysis typifies the fuel used:

	%
Water	2.3
Volatile matter	21.8
Fixed carbon	58.1
Ash	17.8

MANUFACTURE OF SILICA-BRICK. The quartz for the manufacture of this type of brick was obtained from numerous barren milky-white quartz veins that abounded in the immediate vicinity of the works. A typical analysis showed:

	%
Silica	99.40
Alumina	0.25
Ferric oxide	0.15

A set contract-price was paid for the quartz, which was delivered to the brick-works by the contractor. The silica-mill consisted of duplicated units of the following dimensions: 8 by 8-in. rock-breaker, 12 by 12-in. high-speed rolls, and a 6-ft. Chilean mill. The crusher reduced all material to minus 2 in., which passed to rolls set to

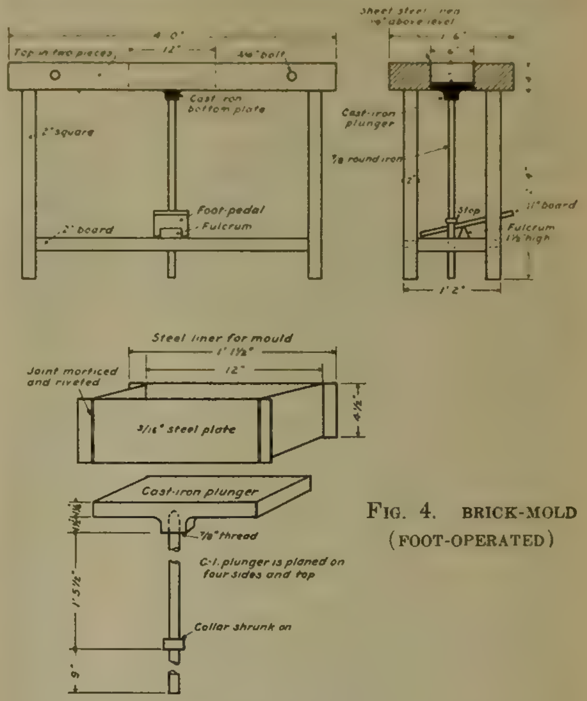

FIG. 4. BRICK-MOLD (FOOT-OPERATED)

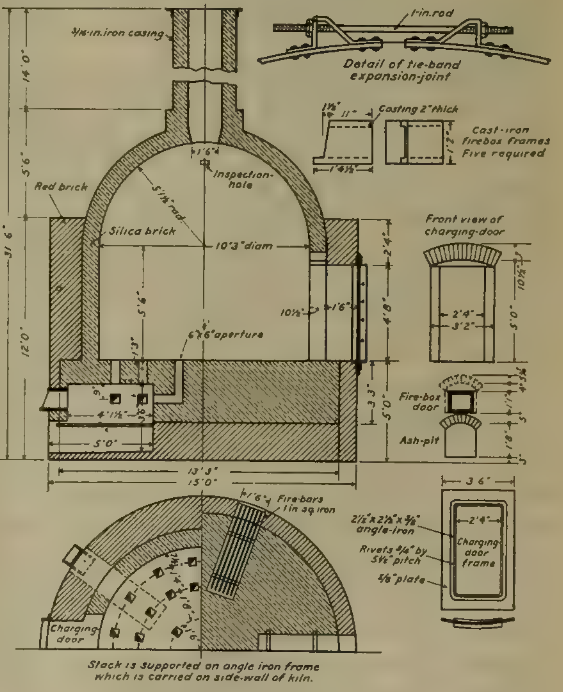

FIG. 3. KILN FOR SILICA BRICK. CAPACITY, 4500 BRICKS OF 10½ BY 5¼ BY 2⅝ INCHES

¾ in.; from the rolls the quartz was fed by hand to the Chilean mill, which ground to minus ¼ in., a bin of 30-ton capacity being used for storing the finished product.

The method adopted for making the silica-lime mixture for brick-making was as follows: freshly burnt lime was thrown into a barrel containing water and thoroughly mixed until all the lime was slaked and in suspension. A hydrometer reading was now taken; and if the mixture was not up to pre-determined strength, more lime or water was added; by this means it was possible to control the lime content of the brick—a most important point in the manufacture of this type of brick. To prepare the silica-lime mixture, a measured quantity of ground quartz was thrown into the Chilean mill and the lime-water mixture was added slowly until just sufficient moisture existed to bind the mass.

The following test was used by the workmen to determine whether the consistence was correct: a handful of the mixture was squeezed, and if after the pressure of the hand had been released the palm was almost dry and the sample retained its shape and did not crumble at the edges the proportion was correct; if too much moisture existed the condition was corrected by adding more quartz and re-grinding. Excellent results are obtained by this method and the lime content of brick (2% CaO) never varied more than 0.1%. Freshly-burnt lime only was used, the small quantity required being made each day by throwing limestone into the boiler fire-box; this was recovered from the spent ashes after they had been discharged from the ash-pit.

A mold similar to that illustrated in Fig. 4 was used for forming the silica-brick; the mixture was tamped into the mold with a wooden mallet, then struck-off level and a ¼-in. steel plate (the exact shape of the mold) was placed on the top of the brick and well hammered to force the coarse and dry material into the corners of the mold. This ensured sharp corners and a compact structure. The brick was now ejected from the mold by the foot-operated plunger, and placed on an iron pallet that was raised about 1 in. by four small legs, which made them convenient to handle. The brick was then transferred to the hot plate, and after eight hours drying was stacked or set in the kiln. Silica bricks in the green state are extremely fragile, and great care was exercised when loading the kiln; all the usual methods of setting were tried, and the following was ultimately adopted: Each brick was set on its end in a series of rings that started from the kiln wall and worked toward the centre. About ½ in. was left between bricks, and ¾ in. between rings. When the brick had been set to such a height that it was difficult for the men to load conveniently, a piece of felt was placed on the top of the brick to prevent it being damaged. The top courses of brick were usually set with odd and difficult shapes, so as to make loading simpler and to minimize breakages. When the kiln was fully set, the charging-doors were closed with a double course of brick, and small fires were lighted in the fire-boxes. These were kept burning slowly for about two days, or until all the moisture had been driven off. The temperature was then raised to 750°C. and maintained thus for 24 hours, care being taken that no extra air was admitted to the kiln. The temperature was now raised to 1400°C. and held at this point for five days. During this period the brick was very sensitive to the ingress of cold air, and every precaution was taken to prevent this happening.

When the fire-boxes required cleaning, only one was done at a time. Until the temperature reached was the same as that of the rest of the kiln, the others were not touched. During the heavy-firing stage the sheet-iron doors of the fire-boxes were dispensed with, and slack coal was used for closing the aperture. A space of only ½ in. was allowed between the top of the slack coal and the top of the fire-box casting; this opening was necessary to supply the requisite amount of air for complete combustion. If any doubt existed as to the condition of the brick after five days' heavy firing, a sample brick was taken from the kiln and, after cooling slowly, it was measured for expansion, and the condition of the quartz grains noted. After a little experience it was possible to judge if the kiln was ready for luting, but the above tests would be unnecessary if pyrometer readings were taken at regular intervals and the correct temperature maintained.

When the burn was completed, all the fire-boxes and ash-pits were bricked up and the top of the stack was covered with an iron plate, after three days this plate was removed, and in another two days the brick was removed from the fire-box and ash-pit openings. The unloading of the brick was started 24 hours after this last period. If due care was exercised during the 'burn' the total failures were under 5%; but with careless handling 25% might be badly cracked and useless. Damaged brick can be re-ground, but this material should be used sparingly, as it tends to raise the amount of lime in the finished brick. About 5% of old brickbats were added to fresh material without impairing the quality of the finished article to an appreciable extent.

The average expansion of silica-brick from the green to the finished state, was allowed for in all molds. While unloading the kiln the brick was sorted into at least two grades, as it was found that quality varied considerably; and only the best could be used in the construction of such equipment as reverberatory-furnace arches.

From 35 to 40% of coal to weight of brick burnt was consumed in the manufacture of the silica-brick. The total cost of production was from $60 to $80 per thousand, whereas the imported variety cost over $240 per thousand and in no way superior to those produced locally.

The following analysis is typical of our silica-brick:

	%
Silica	97.12
Lime	2.05
Alumina	0.30
Iron oxide	0.37

Ganister-Brick. Small quantities of this type of brick were manufactured for the linings of fire-boxes. and were found much superior to fire-brick, as they withstood greater temperatures and were not readily slagged by the ash. Quartz, similar to that used in the manufacture of silica-brick, was the chief constituent; but, in the place of lime as bond, raw fire-clay was used in the proportion of 5 to 95 of silica. The raw fire-clay was mixed with water to the consistence of a thin cream and added to the silica during the final grinding and mixing. Molding and burning operations with this type of brick were identical with those of the silica-brick, but changes of temperature did not affect them so adversely, and for this reason they were placed in the lower courses of the kiln when silica- and ganister-brick were being burnt together.

Ganister-brick does not expand to any great extent under heat; when used in boiler-settings and other small fire-box construction, it was not necessary to provide for expansion if the brick was laid in a thin slurry of raw fire-clay. A typical analysis of the ganister-brick made at our works is as follows:

	%
Silica	93.8
Alumina	4.5
Iron oxide	1.2
Lime	0.1

The cost of producing ganister-brick was from $70 to $75 per thousand.

Stream tin has been found in the gravels of Taylor creek, Squaw creek, and Hardcastle creek; and cassiterite, with specular hematite, occurs in veinlets in soft altered rhyolite at several localities in the Taylor Creek district of New Mexico, states J. M. Hill, in a bulletin of the U. S. Geological Survey. The basalt and the tuff, sandstone, and conglomerate that overlie the rhyolite are barren of mineral deposits. The discovery of stream tin in this district was made by J. N. Welch, who had been prospecting for gold along Taylor creek. Late in 1918 he took some of the heavy black sands he had collected to Chloride, where he wintered. Some of this material was sent to Denver for assay, and the returns showed no gold but 30% of tin. In 1919 he made locations near the caves on Taylor creek. Moliter & Crumley also located ground in this vicinity early in 1919. These claims, together with Welch's ground and several locations in the upper part of Taylor creek, near the Inman ranch, were taken over by the New Mexico Tin & Metals Co., of New York, during the summer of 1919. F. P. Davis and A. D. McDonald, who had been prospecting for tin during the early part of 1919, located placer ground in Taylor creek below Whitetail canyon and on Squaw creek, where a small area of rhyolite containing tin veinlets was also located. These men in 1920 found and located the placer and lode claims on Hardcastle creek, in the north-eastern part of the district. Prior to August 1920 the prospectors had not extended their operations north-west of Corduroy canyon. In fact, no development work had been done except at Cave City, near the mouth of Taylor creek, on Squaw creek, at the then newly discovered locality on Hardcastle creek, and near the McCarty ranch. The gravels of Squaw creek had been tested in a rather systematic manner, and desultory tests of the gravels in other streams had shown the presence of tin. The testing of the gravels of Taylor creek in the vicinity of Cave City had reached only to water-level, as there is a considerable flow of water along this valley. Nowhere was sufficient work done to prove that the deposits could be profitably worked. The developments were confined to the more conspicuous deposits but give a fair idea of the general characteristics of the deposits.

The Chino Copper Co., with its large developed ore-reserves of copper ore at Santa Rita and large milling plant at Hurley, New Mexico, produced 8,913,405 lb. copper during the first quarter of 1921, states a U. S. Geological Survey bulletin; but, as there was no improvement in the copper market during the quarter, the mines and mill of the company were closed on March 31, 1921. Later shipments brought this company's production for the year up to 9,137,282 lb. copper as compared with 46,088,609 lb. in 1920. The Burro Mountain branch of the Phelps Dodge Co., with its copper properties, mill, and townsite at Tyrone, was idle in 1919 but active from August 1920 to March 31, 1921, when it ceased operations. The Pittman Act, fixing the price of silver at nearly $1 per ounce for silver in domestic ores, allowed the Mogollon Mines Co., at Mogollon, to continue operations during 1921. The Aztec gold mine at Baldy, for several years a heavy shipper of gold bullion, did not contribute to the output of gold during the year but continued development work. Placer mining was resumed on Willow Creek, Elizabethtown. The gold and silver mines of Lake Valley and other Sierra County districts continued to make occasional shipments. Much silver ore was shipped from the old Chloride Flat district near Silver City. The shipments of copper-bearing silicious gold and silver ore from Lordsburg were small in comparison with the heavy shipments from that district in 1920. Development work, however, was continued at Lordsburg, and one silver mine was re-opened. Shipments of gold and silver ores were made from Gold Hill, north of Lordsburg. The zinc mines at Hanover continued development work but shipped no ore. The zinc and lead mines at Kelly were closed early in 1921 after making only a few small shipments. The Grubnau Chemical Co.'s zinc-oxide plant at Waldo was operated part of the year on ores from Mexico.

Describing the microscopic forms of iron rust, A. Ackermann, writing in the 'Kolloid-Zeits.', states that the forms exhibited by rust depend in the first place on the formation of ferric hydroxide. This colloidal substance assumes forms and passes through formation processes that are similar to the forms and processes that occur in organic nature. Non-rigid threads are formed which grow like organic fibres and which move and change their form when subjected to change in the external conditions. Under certain conditions cell formation is exhibited, which, externally at least, is similar to organic cell formation. Drops of a solution of ferric hydroxide possess properties that are otherwise only found in organic cells. They exhibit a solid or semi-solid enclosing semi-permeable membrane or cell wall, an adhering colloidal layer, and a nucleus.

Conservation of Compressed Air

By J. P. Cotter

*The purchaser of an air-compressor usually selects a machine of the highest possible efficiency, and one most suitable for his purpose. He exercises great care in its installation, and he subjects it to tests, in order to satisfy himself of its efficiency in operation; but it is regrettable that the same care is not carried into the mines, particularly in the arrangement and upkeep of pipe-lines.

One major cause of loss of efficiency in the mine is air leaks—a loss commonly equivalent to a third of the capacity of the compressor. As a general rule, no attention is paid to small leaks, which are costly and materially lower the efficiency of the plant. For example, a very small hole in a pipe-line—a perforation no larger than one made by a common pin—will cost $60 per year; in other words it would represent a loss of 5 cu. ft. of air per minute. Doubtless if a careful survey of the mine were made, many of these small leaks would be detected; many joints from which air was escaping (that the average official would not consider leaks), would be noted; many valves leaking air around the spindle, and many pumps, coal cutters, donkey-engines, and other machines leaking air past the piston rod at each stroke of the machine, would be found.

But leaks are not the main cause of the loss of efficiency. The largest losses are the result of lack of proper engineering in laying-out underground pipe-lines, which as a rule, are not of sufficient capacity to transmit compressed air to the various working places without a large loss. At mines equipped with a compressor plant of 5000 ft. to 6000 ft. capacity, an 8-in. main air-line is usually installed. Pipe of this size is too small, and will not carry the amount of air mentioned any distance efficiently, because there will be a loss of 2.46 lb. for each 1000 ft. If the pipe-line is 5000 ft. long (a common length in our mines), there will be a total loss of 12.30 lb. If this particular pipe-line was 12 in. instead of 8 in. the friction less would be reduced to 0.30 lb. per 1000.

The main lines are not the worst. It is in the branch lines that the greatest loss occurs. It is not uncommon in a mine to find a headway, requiring from 1000 to 1200 cu. ft. of air, piped with a 2-in. air-line. The loss in such a case is great—much over 50%. A headway or section requiring that amount of air should have a pipe-line at least 4 in. diameter, and, for good efficiency, it would be better if it were 5 in. diameter. As much care should be given to the lay-out and installation of underground pipe-lines as is given to the installation of the compressor. It is possible to design an underground pipe system that will give a uniform velocity through the main-line and branches. The result of such an installation would be a cheaper output, and contented officials and miners. A miner cannot possibly produce a maximum output when operating a machine where pressure is reduced.

The presence of water in compressed air is undesirable and should be avoided; it tends to cause freezing, and reduces the effect of the lubricating oil. There is, of course, no such thing as a perfectly dry atmosphere. Moisture is always present; it remains in the air as an invisible vapor until the point of saturation, or 100% humidity, is reached. This, the dew-point, is always reached in the compression and transmission of air at the ordinary working pressures, say 6 atmospheres or 75 lb. gauge; and, immediately the point of saturation is passed, the excess of moisture condenses into actual visible particles of water, but still mixed with the air, the super-saturated air then appearing as a fog or mist.

The saturation point of air varies constantly, and is determined by its pressure and its temperature, especially the latter. At a fixed temperature, any given volume of air is saturated when it contains a certain definite quantity of water vapor. If the absolute pressure of a certain quantity of air is, say, doubled, by which the volume is reduced one-half, the moisture-holding capacity is reduced in the same proportion. Thus, if the humidity of the free air is 50%, this becomes 100% when the air is compressed to 2 atmospheres, or 15 lb. gauge. Similarly, if it is compressed to 6 atmospheres, 90 lb. absolute, or 75 lb. gauge (a common working-pressure), the humidity becomes 300%; in other words, two-thirds of the moisture will separate as water, and only one-third will be carried as vapor.

These figures are based on the assumption that the temperature of the air remains constant, but that is far from being the case. As air is compressed, its temperature rises rapidly, and with each rise of about 20° its capacity for holding moisture is doubled. Starting with free air at 60°F., and compressing it to 75 lb. gauge, its temperature at delivery will be above 300°, no matter how perfectly the cylinder may be cooled. In consequence of this rise in temperature, the capacity of the air for holding moisture will have been increased to such an extent that when it leaves the cylinder the relative humidity will be low, although the air still carries all the moisture with which it started.

It is to be borne in mind that the conditions under which compressed air will have the lowest capacity for holding moisture are high pressure and low temperature. As the air leaves the compressor, and before it begins to be used, it is, of course, at its highest pressure. In its flow through the pipes, the temperature is reduced, so that when it arrives at the point where work is to be done it should be at a low temperature and with a minimum of moisture, if means have been provided for getting rid of the moisture as it condenses.

By passing the air through an after-cooler, and reducing its temperature to approximately its initial pre-compression temperature, it is clear that a large percentage of the moisture will be condensed and removed before it can enter the pipe-line, due to the fact that, as shown above, the compressed air has less capacity than the original air for holding moisture. Moisture that condenses and collects in air pipe-lines causes water-hammer, tends to make joints leaky, and causes loss of power.

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*Discussed at a meeting of the Mining Society of Nova Scotia, at Halifax.

Cyanidation of Flotation Concentrate

By Paul T. Bruhl

INTRODUCTION. The fall in the market price of silver made it of added interest to the Sabana Grande-Honduras Mining Co. to determine whether the flotation concentrate produced in the mill and formerly shipped to the United States could be treated more profitably on the spot. As local smelting was out of the question, and as efforts to make the concentrate of higher grade were not successful from the economic viewpoint, it was clear that cyanidation offered the most promising field. The problem to be solved was this; 60 tons of flotation concentrate is produced monthly and shipped at a cost of $70 per ton, including freight and treatment charges, to the smelter, which pays for 95% of the silver and for all of the gold. Can bullion be produced locally more cheaply, and will the saving cover the expense for additional equipment, power, and labor in a short period of time? An incomplete analysis of the concentrate shows:

Ag	409.10 oz.	Bi	0.02%
Au	1.67 "	S	28.10 "
Zn	3.50%	Pb	3.10 "
Sb	0.16 "	As	0.50 "
Mn	0.85 "	Fe	22.80 "
Cu	0.68 "	Insoluble	34.80 "

The important minerals present are stephanite, pyrite, marcasite, mispickle, galena, and zinc-blend—a conglomeration that is not ideal for cyanidation. The results of the experiments cannot be tabulated concisely, for the work was done as opportunity offered, and only such information was sought as seemed necessary for the elucidation of some point of immediate interest. Therefore, the record is not a complete one, but, nevertheless, it illustrates the successive steps taken in the endeavor to find the right track; it is hoped that the results may prove of assistance to other experimenters in the same field.

Freshly prepared sodium cyanide solution was used in each test, the crystals being dissolved in lime-water, and the cyaniding being done in revolving bottles to which air had free access. The percentage of cyanide is given in terms of free potassium cyanide. The tailing samples were washed thoroughly with water before assay, and are therefore lower in precious metal than they would be in actual practice. All assays were made in triplicate, and the only correction applied was that for cupellation loss. I am glad to acknowledge the co-operation of H. J. Mainell in the major portion of the work.

Experiment 1—Cyanidation of Raw Concentrate

Agitation hr.	Dilution	Heading Ag oz.	Heading Au oz.	Tailing Ag oz.	Tailing Au oz.	Extraction Ag %	Extraction Au %	Remarks
72	6:1	408.0	1.72	298.5	0.30	26.8	82.6	Unwashed heading
72	6:1	408.0	1.72	293.0	0.30	28.2	82.6	Washed heading

Before test KCN %	Before test CaO %	Consumption per ton of concentrate KCN lb.	Consumption per ton of concentrate CaO lb.	Remarks Added 1 gm. 33% CaO to heading
0.88	0.08	26.7	5.0	Unwashed heading
0.88	0.08	25.8	2.75	Washed heading

As the extraction obtained by cyaniding the raw concentrate was so poor it was decided to roast it prior to cyanidation. No pyrometer was available, and the temperatures at which roasting was conducted are expressed, consequently, in relative terms. The muffle-furnace was in a room that was darkened during the experiments.

Experiment 2—To Determine Whether Hot or Cold Water is Necessary for the Preliminary Wash of Roasted Concentrate

Agitation min.	Dilution	Loss of weight in wash %	Silver in solution gm.	Remarks
30	4:1	7.4	0.088	Cold wash
30	4:1	7.2	0.088	Hot wash

The silver in solution is derived from the soluble sulphate of silver formed in the ore when it is partly roasted at a bright-red heat. A hot wash is obviously of no benefit.

Experiment 3—Roasting for One Hour at a Bright-Red Heat Prior to Cyanidation. The Charge Was Rabbled During the Roast

Sulphur At start A %	Sulphur After 30 min. B %	Sulphur After 1 hr. C %	Assay value Ag oz.	Assay value Au oz.	Loss of weight during roasting %
23.57	6.54	1.39	A 408.0	1.72	.....
....	...	...	C 486.0	1.89	C 17.6

The roasted concentrate was washed with water for 45 minutes; there was a loss in weight of 5.53%; common salt was added to the filtrate, with the result that 11.57% of the silver in the raw concentrate was precipitated as silver chloride.

Agitation hr.	Dilution	Heading Ag oz.	Heading Au oz.	Tailing Ag oz.	Tailing Au oz.	Loss by volatilization and dusting Ag %	Loss by volatilization and dusting Au %	Remarks
72	6:1	408.0	1.72	354.0	1.42	1.85	9.5	Tailing calculated on raw concentrate

	Silver %	Gold %
Theoretical extraction	13.20	17.4
Extraction in wash	11.57	Trace
Roasting-loss	1.85	9.5
Actual extraction	−0.22	7.9

Before test KCN %	Before test CaO %	Consumption per ton of raw concentrate KCN lb.	Consumption per ton of raw concentrate CaO lb.	Remarks
0.944	0.082	56.6	0.95	1 gm. 33% CaO added to heading

The results show that it is inadvisable to roast the concentrate at a bright-red heat. Considering that no silver or, as some tests showed, very little silver enters into combination with the salt, the cyanide consumption is high, due doubtless to the conversion of the sulphide and oxide of zinc. The insolubility of the silver may be due to contamination of the metallic silver formed during the de-sulphatization of sulphate of silver. Possibly the gold is similarly contaminated. The concentrate was kept constantly stirred during the roast and there was no sign of fritting.

Experiment 4—Roast Conducted at an Incipient Red Heat for One Hour. The Charge Was Rabbled During the Roast

Sulphur At start A %	Sulphur After 1 hr. B %	Sulphur After 1 hr. wash %	Assay value Ag oz.	Assay value Au oz.	Volatilization loss Ag %	Volatilization loss Au %	Loss in weight in roast %
23.57	6.30	5.61	A 408.0	1.72	...	..	..
....	...	...	B 455.5	1.80	Nil	5.8	10.0

No precipitate of silver chloride was formed by the addition of salt to the filtrate.

Agitation	Dilution	Heading		Tailing		Extraction		Remarks
		Ag	Au	Ag	Au	Ag	Au	
hr.		oz.	oz.	oz.	oz.	%	%	Calculations based
72	6:1	408.0	1.72	66.5	0.45	83.7	73.8	on raw concentrate

Before test		Consumption per ton of raw concentrate		Remarks
KCN	CaO	KCN	CaO	
%	%	lb	lb.	
0.88	0 08	70.7	0.40	1 gm. 33% CaO added to cyanide heading

Experiment 5—The Roast Was Conducted at a Dull-Red Heat for Two Hours. The Charge Was Rabbled During the Roast

Loss of weight in roast	Loss of weight in water-wash	Extraction by lixiviation	
		Ag	Au
%	%	%	%
15 0	8.7	15.9	13.5

	Raw concentrate	Roasted concentrate	Wash-water	Cyanide heading
	%	%	%	%
Sulphur	23.57	4.21	0.97	3.24

Agitation	Dilution	Heading		Tailing		Theoretical extraction		Remarks
		Ag	Au	Ag	Au	Ag	Au	
hr.		oz.	oz.	oz.	oz.	%	%	Calculations based
72	6:1	408.2	1.72	107.2	0.84	73.7	51.2	on raw concentrate

Before test		Consumption per ton of raw concentrate		Remarks
KCN	CaO	KCN	CaO	
%	%	lb.	lb.	
0.73	0 101	46.2	11.1	½ gm. 33% CaO added to cyanide heading

Experiment 6—A Portion of the Roasted Concentrate from Experiment 5 Was Cyanided, After a Water-Wash, and After 28 Hours the Cyanide Solution in the Test Was Replaced by Fresh Solution

Agitation	Heading		Tailing		Theoretical extraction	
	Ag	Au	Ag	Au	Ag	Au
hr.	oz.	oz.	oz.	oz.	%	%
72	408.2	1.72	106.5	0.84	73.9	51.2

Experiment 7—A Portion of the Roasted Concentrate from Experiment 5 Was Cyanided, After a 0.082% Lime-Water Wash, at 6:1 Dilution. Lime Consumption Was Complete. Loss of Weight Due to Wash Was 6.7%

Agitation	Dilution	Heading		Tailing		Theoretical extraction	
		Ag	Au	Ag	Au	Ag	Au
hr.		oz.	oz.	oz.	oz.	%	%
72	6:1	408.2	1.72	147.6	0.88	63.8	48.8

The results of experiments 3 to 7 could not be considered satisfactory; the losses by volatilization and dusting were high, the extraction was low. Furthermore, it is not desirable to produce, in the roast, silver and gold salts that are soluble in the water-wash that precedes cyanidation. It was, therefore, decided to try the effect of a chloridizing roast.

EXPERIMENT 8. CHLORIDIZING ROAST FOLLOWED BY CYANIDATION

Eighty grammes of roasted concentrate was moistened with water and 8 gm. of salt was incorporated in the mass. The mixture was placed in a dull-red furnace for two hours, the charge being rabbled occasionally.

Weight of raw concentrate	Weight after chloridizing roast	Weight after water-wash
gm.	gm.	gm.
94	87.8	70.8

	Raw concentrate	Roasted concentrate	After wash	After cyanidation
	%	%	%	%
Sulphur	23.57	4.21	3.24	..
Zinc	4.60	4.90	2.70	2.2

Agitation	Dilution	Heading		Tailing		Extraction		Remarks
		Ag	Au	Ag	Au	Ag	Au	
hr.		oz.	oz.	oz.	oz.	%	%	Calculations based
72	6:1	408.3	1.72	21.73	0.113	94.67	93.43	on raw concentrate

Before test		Consumption per ton of raw concentrate		Volatilized in roast and dissolved in wash		Remarks
KCN	CaO	KCN	CaO	Ag	Au	
%	%	lb.	lb.	%	%	1 gm. 33% CaO added to
0 73	0 101	57.5	12.6	6.78	16.85	cyanide heading

The theoretical extraction in the foregoing experiment was so much better than that previously obtained that further work in chloridizing roasting was justified.

EXPERIMENT 9. CHLORIDIZING ROAST WITH VARYING PROPORTIONS OF SALT

The raw concentrate was roasted at a dull-red heat for two hours; after the addition of salt it was heated at the same temperature for a further two hours. The charge was rabbled occasionally.

Raw concentrate		Roasted concentrate		Loss of weight in roast	Volatilization and mechanical loss	
Ag	Au	Ag	Au		Ag	Au
oz.	oz.	oz.	oz.	%	%	%
412.0	1.70	468.0	1.84	15.87	4.43	8.94

	Raw concentrate	Roasted concentrate
	%	%
Sulphur	26.3	3.7
Zinc	4.8	2.3

Test No.	NaCl	After chlorination		Loss in chlorination		Remarks
		Ag	Au	Ag	Au	
	%	oz.	oz.	%	%	
1	2	443.0	1.80	1.85	nil	Charge
2	5	426.0	1.75	3.16	0.18	moistened
3	10	414.0	1.60	1.36	3.94	before
4	10	415.0	1.60	2.30	5.03	chlorination

After chlorination the ore was given a water-wash for two hours.

The percentage of silver and gold in raw concentrate found in the filtrate:

	1	2	3	4
Silver, %	0.50	0.37	0.41	0.43
Gold, %	0.03	0.02	0.02	0.02

Test No.	Agitation hr.	Dilution	Before test		Consumption in pounds per ton of raw concentrate		Theoretical extraction		Remarks
			KCN	CaO	KCN	CaO	Ag	Au	
			%	%	%	%	%	%	½ gm. of
1	90	6:1	0.775	0.102	31.6	13.0	74.7	52.3	33% CaO
2	90	6:1	0.775	0.102	44.9	11.8	91.5	90.8	added to
3	90	6:1	0.775	0.102	51.7	11.2	95.2	89.4	cyanide
4	90	6:1	0.775	0.102	49.6	10.1	93.4	86.6	heading

It was now clear that by subjecting the concentrate to a chloridizing roast it could be rendered amenable to cyanidation. The volatilization and mechanical losses, more especially of the gold, were heavy; to reduce them it was decided to add the salt to the raw instead of to the partly roasted concentrate, to avoid rabbling the charge, and to lower the furnace-temperature.

Experiment 10—Roasting at Just Below Visible Heat Without Rabbling the Charge

	Test No.					
	1	2	3	4	5	6
Weight before roast, gm.	70	70	70	70	70	70
Duration of roast, min.	20	40	60	20	40	60
Weight after roast, gm.	65.90	65.90	65.70	73.30	73.00	73.60
Assay raw concentrate:						
Ag, oz.	402.30	402.30	402.30	402.30	402.30	402.30
Au, oz.	1.70	1 70	1.70	1.70	1.70	1.70
Assay roasted concentrate:						
Ag, oz.	421.50	420.50	421.00	393.20	397.80	382.60
Au, oz.	1.80	1.70	1.82	1.65	1.70	1.70
Weight before water-wash, gm.........	50	50	50	50	50	50
Weight after water-wash, gm.........	48.40	43.90	47.20	46.30	43.40	41.90
Ag and Au in filtrate.	nil	nil	nil	nil	nil	nil
Cyanide heading:						
Ag, oz.	435.40	479.00	446.00	424.60	458.30	456.50
Au, oz.	1.86	1.93	1.93	1.78	1.96	2.03
Cyanide tailing:						
Ag, oz.	69.60	45.90	93.90	70.00	27.60	42.80
Au, oz.	0.80	0.67	0.90	0.80	0.43	0.40
Theoretical extraction:						
Ag, %	84.00	90.40	78.90	83.50	93.90	90.60
Au, %	57.00	65.30	53.40	55.10	78.10	80.30
Volatilization loss:						
Ag, %	1.36	1.59	1.78	nil	nil	nil
Au, %	0.34	5.88	nil	nil	nil	nil

To tests No. 4, 5, and 6 was added 10% of salt.

No.	Agitation hr	Dilution	Before test KCN %	Before test CaO %	Consumption per ton of raw concentrate KCN lb.	Consumption per ton of raw concentrate CaO lb	Remarks
1	70	9:1	0.5	0 117	50.1	14 3	1 gm of 37% CaO added to cyanide heading
2	70	9:1	0 5	0.117	50 1	9 6	
3	70	9:1	0 5	0 117	50 5	14 9	
4	70	9:1	0 5	0 117	56 0	18 4	
5	70	9:1	0 5	0 117	55 2	10 9	
6	70	9:1	0 5	0.117	55.7	17.3	

The beneficial effect of adding salt to the charge before roasting is seen by a comparison of results of tests No. 5 and 6 with those of tests No. 2 and 3. The advantage of not rabbling the charge is made clear by the much smaller volatilization losses. The extraction of gold, however, is poor, and to remedy this the roasting temperature in the next experiment was raised to an incipient red heat.

Experiment 11—Roasting for Two Hours at Incipient Red Heat Without Rabbling the Charge. 10% NaCl Added to Tests 2 and 4. Assay-Value of Raw Concentrate: Ag, 400.1 oz.; Au, 2.07 oz.

	Test No. 1	2	3	4
Weight before roast, gm	69.00	69.00	69.00	69.00
Weight after roast, gm	64.60	75.00	68.90	75.80
Weight before water-wash, gm	50 00	50.00	50.00	50.00
Weight after water-wash, gm	45 40	38.80	48.40	44.10
Ag and Au in filtrate	nil	nil	nil	nil
Assay roasted concentrate:				
Ag, oz.	414.30	358.70	405.00	303.60
Au, oz.	2 00	1.90	2.00	1.95
Assay cyanide heading:				
Ag, oz.	470.60	474.30	414.10	412.80
Au, oz.	2.43	2.46	2.14	2.14
Assay cyanide tailing:				
Ag, oz.	45.50	18.40	52.30	7.90
Au, oz.	0.46	0.87	0.19	0.43
Theoretical extraction:				
Ag, %	90.30	96.10	87.40	98.10
Au, %	81.10	64.60	91.10	80.00
Loss by volatilization:				
Ag, %	3.05	2.55	nil	0.17
Au, %	9.52	0 21	3.50	nil

No.	Agitation hr.	Dilution	Before test KCN %	Before test CaO %	Consumption per ton of raw concentrate KCN lb.	Consumption per ton of raw concentrate CaO lb.	Remarks
1	72	10:1	0.935	0.102	46.7	12.4	½ gm. of 37% CaO added to cyanide heading after 24 hr. agitation
2	72	10:1	0.935	0.102	75.9	19.3	
3	72	10:1	0.935	0 102	67.6	2.0	
4	72	10:1	0.935	0.102	67.8	8.1	

The concentrate in tests No. 3 and 4 was kept closely covered, so as to maintain as far as possible a non-oxidizing atmosphere. The extraction of gold in test No. 2 is unexpectedly low. The addition of salt at the roasting-temperature maintained in the experiment appears to affect the extraction of gold adversely, whereas keeping the concentrate covered during the roast appears to improve it. The higher temperature, however, gives better results than those obtained at the lower temperature at which the previous experiment was conducted.

Experiment 12—Heating for Two Hours at a Dull-Red Heat, Without Rabbling the Charge in a Non-Oxidizing Atmosphere; 7.0 gm. NaCl Added Before Roast. Assay-Value Raw Concentrate: Ag, 395.2 oz.; Au, 1.65 oz.

	Test No. 1	2
Weight before roast, gm	77	77
Weight after roast, gm	75.60	76.00
Weight before water-wash, gm	50.00	50.00
Weight after water-wash, gm	44.20	44.20
Ag and Au in filtrate	nil	nil
Assay roasted product:		
Ag, oz.	364.00	367.10
Au, oz.	1.45	1.45
Assay value cyanide heading:		
Ag, oz.	411.70	415.00
Au, oz.	1.64	1.64
Assay value cyanide tailing:		
Ag, oz.	8 40	7 70
Au, oz.	0.27	0.22
Theoretical extraction:		
Ag, %	98 00	98 10
Au, %	83.50	86 00
Volatilization loss:		
Ag, %	0.53	nil
Au, %	5 10	4 60

No.	Agitation hr.	Dilution	Before test KCN %	Before test CaO %	Consumption per ton of raw concentrate KCN lb	Consumption per ton of raw concentrate CaO lb.	Remarks
1	72	10:1	0.865	0.120	50 0	8.4	½ gm of 37% CaO added to cyanide heading
2	72	10:1	0 865	0.120	50.0	2.4	

The higher roasting temperature results in larger losses by volatilization. The correct roasting temperature appears to be that corresponding to an incipient red heat.

The following comparative results were obtained when using ozonized and non-ozonized air for agitation.

Heading: 16.87 oz. Ag; 0.08 oz. Au; 0.40% Zn; plus 150-mesh, 5.7%.

Agitation 12 hr. Ag, oz.	12 hr. Au, oz.	24 hr. Ag, oz.	24 hr. Au, oz.	48 hr. Ag, oz.	48 hr. Au, oz.	Remarks
Assay value of residue						Cyanide solution contained 10.2 lb. free KCN per ton
3.80	0.006	3.26	0.006	2.90	0.006	Non-ozonized air
5.32	0.008	3.34	0.006	3.18	0.006	Ozonized air

Percentage of extraction

Non-ozonized air Ag	Non-ozonized air Au	Ozonized air Ag	Ozonized air Au	
77.5	92.5	68.4	90.0	After 12-hr agitation
80.7	92.5	80.2	92.5	After 24 " "
82.8	92.5	81.2	92.5	After 48 " "

Consumption in pounds per ton of ore

	Free NaCN	Lime	Free KCN	Lime	
Non-ozonized air	5.40	12.19	7.68	20.7	After 24-hr. agitation
Ozonized air	6.30	15.93	10.98	25.45	After 48 " "

The experiments show that the use of strongly-ozonized air for agitation is detrimental to the cyanidation of Rosario ore. There is sufficient oxygen dissolved from ordinary compressed air to take care of any reducing agents and to satisfy Elsner's equation. The ozonized air merely causes the passage, through the solution, of bubbles possessing oxidizing properties far in excess of what is required. This excess is, of course, of no value; it is, on the contrary, harmful, inasmuch as it acts as a cyanicide and a destroyer of calcium hydrate. It probably promotes the solution of the base metals, so that the silver and gold dissolve less readily owing to the increased viscosity of the solution. I had expected that the extraction of silver would be more rapid at the commencement of the experiment when employing ozonized air, but this did not prove to be the case, probably because the formation of reducing agents is slow, and the amount of oxygen dissolved from non-ozonized air is at all times sufficient to neutralize their effect. The cyanide consumption in the experiments is higher than in actual practice because of the low alkalinity, the greater cyanide strength, and the more violent agitation. The amount of ozone used was in considerable excess of what would be used under normal working conditions. It helped to show, however, that ozone is of no use so long as the pulp is well agitated with compressed air. Ozonized air would be of benefit only in the case of ores that readily yield relatively large quantities of reducing salts to the solution. This benefit would be manifested not by an increase in ultimate extraction but by a saving in time of treatment. If we may accept the results of these experiments it would appear inadvisable for us to ozonize. even in part, the compressed air going to the Pachuca vats.

Summary. A satisfactory extraction cannot be obtained by the direct cyanidation of the raw concentrate; ordinary roasting does not give uniform results and causes losses by volatilization and dusting that are serious, for the tonnage of concentrate produced in the mill does not permit of any but the simplest additions to the present equipment. A high roasting-temperature is fatal to success, for besides rendering the concentrate unamenable to cyanidation, it converts some of the gold and silver into salts that are soluble in water. To keep the consumption of cyanide within reasonable limits, it is necessary to wash the roasted concentrate prior to cyanidation. Hence the formation of gold and silver salts that are soluble in water would further complicate the flow-sheet and must, consequently, be avoided. Fair but uneconomic results are obtained by ordinary roasting at an incipient red heat. A chloridizing roast at the same temperature results in a much higher extraction, and further improvements are effected by not rabbling the charge, and by heating it in a non-oxidizing atmosphere. The results of the laboratory experiments seem promising, and further work on a larger scale will therefore be initiated.

I am indebted to A. R. Gordon, general manager for the New York & Honduras Rosario Mining Co., for permission to publish this article.

At a recent meeting of the Lancashire branch of the Institution of British Foundrymen, J. D. Paton described the characteristics and properties of a white metal made from magnesium, which, he said, would assume great importance in the future for the production of light castings. It was much lighter than aluminum—the weight ratios being approximately, magnesium 1, aluminum 2, iron 6—and could be substituted for aluminum in almost all its uses. Being compelled to find such a substitute during the War, the Germans resorted to magnesium because experience had already shown that the metal would partly meet requirements. The developments that took place in Germany resulted in an output of the new metal which was equivalent to the pre-war world consumption of aluminum—between 20,000 and 30,000 tons. The casting of magnesium required care, highly-dried molds and cores being essential; but the molder could readily acquire some knowledge of the physical and mechanical characteristics of the metal; and with careful handling, correct heating, and dry floors and molds, castings could be produced without trouble or danger of explosion. About 500 lb. of coke would smelt 1000 lb. of metal, the heat consumption being only two-thirds of that needed in the case of aluminum. For thick-walled castings a pouring temperature of 650° to 680°C. was required; and for thin-walled castings, 700° to 750°C. When cast at the correct temperature in a perfectly dry mold, the metal was of a silvery color. It was ductile, and was used in innumerable ways, as, for instance, in aircraft parts; in the electrical industry, in all cases where aluminum was then used; and in the textile industry, where parts of machinery then made of cast-iron could be made of magnesium, the reduction in weight leading to economy in power. A reduction might also be effected in transport costs by the use of the metal.

Quicksilver in 1921

Preliminary figures showing the production of quicksilver in the United States in 1921, compiled by F. L. Ransome, of the U. S. Geological Survey, give a total of 6339 flasks, as compared with 13,392 flasks in 1920. Of this output 3094 flasks is credited to California, 3144 to Texas, 100 to Nevada, and 1 to Idaho. So far as could be learned, Oregon produced no quicksilver in 1921.

In California seven mines reported production, but the output from all but the El Senador mine, of the New Almaden group, was small. The New Idria mine, for many years the largest producer of quicksilver in the United States, was idle in 1921. In Texas the Chisos was the only mine that remained continuously productive, but a small output was expected in December from the Mariscal mine, near McKinney Springs, and is included in the total. In Nevada about 100 flasks was obtained in the Pilot mountains, east of Mina. The single flask reported from Idaho was retorted incidentally to development work in the Yellow Pine district, Valley county. During the year the United Mercury Mines Co. acquired over 100 claims that were formerly held by the Idaho Quicksilver Co., the Monumental Mercury Mines Co., and other companies in the Yellow Pine district.

In Oregon, the War Eagle Mining Co., operating what was formerly known as the Rainier mine, in Jackson county, completed a 25-ton Scott furnace in 1920 but is not known to have produced any quicksilver in 1921.

The average price of quicksilver in 1921 per flask of 75 pounds, as quoted by the 'Mining and Scientific Press' for the San Francisco market, was $47.42. The highest monthly average was $50, in January and May; the lowest was $40.40 in November. The average for December rose to $49.50.

Never before has the quicksilver industry in the United States sunk to so low an ebb. The first recorded annual production was 7723 flasks, in 1850, and from that year to 1920 inclusive the annual output has been 10,000 flasks or more—in fact in only five years has it been less than 20,000 flasks. In 1859 it was 13,000 flasks; in 1960, 10,000; in 1908, 19,750; in 1914, 16,548; and in 1920, 13,392. The maximum output, that of 1877, was 79,395 flasks. The output in 1921 was thus the smallest on record. The average price in 1921, although of course much lower than that for the years during and immediately after the War, nevertheless compares favorably with pre-war prices. The average price during the 10 years from 1904 to 1913, inclusive, was $42.32, or $5.10 per flask lower than the average in 1921. The cost of production, however, has not declined so rapidly as the price, and no large bodies of ore are now known that are comparable in tenor to those that were exploited when quicksilver mining in the United States could be considered a flourishing industry.

Book Reviews

The Economic Aspects of Geology, by C. K. Leith. 457 pp. Published by Henry Holt & Co., New York. For sale by the 'Mining and Scientific Press'. Price, $5.

This is an important addition to the current literature of mining; it is a comprehensive survey of the world's mineral resources by a writer especially competent for the task. The author of the book has won a reputation as a scientific man of keen acumen and intellectual honesty; he brings to his subject the literary skill and philosophic insight required to hold the interest of thoughtful readers outside the ranks of the technicians; in short, he has produced an educative book valuable to the community as a whole. Of Mr. Leith's qualifications we need only say to those not familiar with the details of his career that he has been on the staff of the U. S. Geological Survey for more than twenty years; since 1903 he has been Professor of Geology in the University of Wisconsin, from which he graduated in 1897; he is a Ph.D. of the same university. He is the author of several scientific monographs and has contributed generously to the literature of geology, more particularly in its application to mining; in short, he is pre-eminently an economic geologist, and as such is peculiarly fitted to write the book here under review.

In the 'Introduction' the author states that his purpose is "to explain the nature of the economic demands for the science of geology, and to discuss something of the philosophy of the finding and the use of raw materials. Somewhat generalized statistics are used as a means of gaining perspective. No effort has been made for detailed accuracy or for completeness. So far as possible the quantitative features are expressed in general proportions, and where specific figures are given they are meant to indicate only such general proportions. The thought has been not to be so specific that the figures would soon be out of date". It will not be inferred, therefore, that the book is loaded with indigestible masses of statistics; on the contrary, the statistics are relatively few and are given in a form best adapted to illustrate and explain the author's generalizations. His own experience in the field is based primarily on his early familiarity with the iron and copper deposits, and the industries based thereon, of the Lake Superior region, but he is able also to draw upon his personal knowledge of the principal mineral regions of the United States, Canada, Mexico, and Cuba, as well as many districts in South America and Europe. Evidently his training and experience unite in fitting him to do justice to his subject.

The 21 chapters cover all the principal phases of his inquiry, notably the classification and origin of minerals and ores, the distribution and mode of occurrence of the principal deposits, the exploration and development of mineral resources, besides special discussions of water as a mineral resource, the fertilizer group of minerals, the valuation and taxation of mineral resources, the laws relating to them, the conservation of them, and the international aspects of their exploitation. These headings indicate the wide scope of the book and its highly interesting character. For example, I was attracted to the chapter on mining laws, because I was curious to read what the author had to say on apex litigation, knowing that he is one of the experts foremost in the trial of cases involving the extra-lateral right. It is fair to add that Mr. Leith is "foremost" not only by reason of his skill as a witness but in the reputation he bears for intellectual honesty, the one quality that renders such testimony worthy of a true scientist. He recognizes the criticism that has been aimed at 'expert' testimony in the courts and replies to it in a judicial spirit. Indeed, he deals with this phase of the subject so well that I think it desirable to reprint what he has to say on the matter in an early issue of the 'Mining and Scientific Press'. Therefore on the present occasion I shall quote only one paragraph: "It is to be remembered that apex cases are only one kind of a vast variety of cases affecting mineral resources. At one time or another, and in some connection or another, practically every geologist of considerable experience has found it necessary to testify on geologic matters in court. The wide interest attaching to certain spectacular apex cases has led in some quarters [is he cocking an eye at the 'M. & S. P.'?] to hasty criticism of the participation of geologists therein, without apparent recognition of the fact that the criticism applies in principle to many other kinds of litigation and to practically all economic geologists. This criticism also fails to take cognizance of the fact that, for every case tried, there are many settled out of court through the advice and co-operation of geologists".

Another interesting chapter is the one devoted to the general relations of the geologist to exploration and development. This is the special field of the economic geologist and the one that gives him the largest opportunity for the exercise of his talent. It affords a quantitative measure of the accuracy of his scientific thinking. The author makes a good case for his profession: "The argument is sometimes made that many mineral deposits have been found without geologic assistance, and that therefore the geologist is superfluous. The answer to this argument is that there are often hundreds of 'practical' explorers in the field to one geologist, and that in proportion to numbers the story is quite a different one. The very fact that many large mining organizations, as a result of their experience, now leave these matters of exploration and development largely in the hands of geologists, is a tribute to the usefulness of the science". Yes, it is. In our issue of September 24, 1921, I described the methods of the geological department of the Anaconda Copper Mining Co. at Butte, as typical of the best modern practice in this respect. During the last twenty or twenty-five years there has been a notable increase of respect for the practical usefulness of the geologist as a guide to those conducting large-scale mining enterprises, and he is fully entitled to that respect by the evidence of the results he has achieved. Mr. Leith himself is one of those who have contributed largely to the high favor in which the economic geologist is held by the men who are making money out of mines. He makes a wise remark about the chances of discovery in old districts: "It is safe to say that very few mineral districts are thoroughly understood and explored. Numerous important discoveries of recent years have been in the extensions of old mines and old districts; and when one considers the scale of even the most extensive mine-openings in comparison with the vast body of rock available for exploration, it is clear that this will continue to be the situation far into the future. It is the writer's belief that the economic geologist stands at least as good a chance of success in exploration in the older districts as he does in new fields". He makes a plea for co-operation in exploratory work. "Individuals and companies may handicap themselves greatly by a desire to play a lone hand, and by failure to take advantage of an exchange of information . . . Financial and other conditions may require this attitude; but in large part it is a result of temperament, as clearly indicated by the difference in methods followed by different groups and in different mining districts. From a scientific point of view this attitude can hardly be justified, in view of the extremely narrow limits of human knowledge as compared with the scientific field to be explored. The sum total of knowledge from all sources is only a small fraction of that necessary for the most effective results. The mutual exchange of information and discussion is usually justified on the basis of self-interest alone, to say nothing of the larger interest to the mineral district, to the country, or to science." I venture to add that, of the little an individual may know, the larger part was given to him gratuitously; also that the addition that any individual may be able to make to the sum of human knowledge is only an insignificant fraction; further, that one of the best ways of obtaining information is to give the little that one has. A book such as this under review is an example of the giving of knowledge by one for the benefit of the many. The pecuniary reward for writing such a book is a trifle compared with the money that may be made by aid of the advice and suggestions it contains. We commend it to the mining profession and also to those who are operating mines as owners; they will find much in it that is interesting and useful, even educative in a broad way, for the author is a social philosopher as well as a scientific observer, bringing to his task the good sense of business matters as well as the learning of the schools. The book is written in a style that is pleasing; the phrasing may not be flawless, but it is unaffected and perspicuous, and that is what a technical book should be. It is a splendid justification of economic geology and a highly effective vindication of the status of the economic geologist in mining affairs.—T. A. R.

Valuation of American Timberlands. By K. W. Woodward. John Wiley & Sons, New York. 246 pp., ill. For sale by 'Mining and Scientific Press'. Price, $3.

This book, as stated in the preface, aims to supply information needed by the investor and the student of forestry—to give for the continental United States and its outlying territories the principal facts in regard to timber resources. Hawaii has been omitted because its timber is useful mainly for its protective value, and cutting in the commercial sense is only possible on a limited scale. Likewise the Canal Zone is not attractive to either the saw-mill man or to the timber investor, by reason of the small area under the control of the United States. The investor will find data that will enable him to deduce what cost will be incurred by the examination of a tract; he will also obtain the salient features of the general type of which the holdings may form but a small part. For the student of forestry it will fill an additional purpose. Few attempts have been made before to gather in one volume concise descriptions of all the types in the United States. A forest type is used to denote an area that has the same climatic, topographic, and soil conditions, and hence tends to have the same composition. The contents are as follows: I. Northern spruce type. II. Northern hardwood type. III. White pine type. IV. Swamp type. V. Southeastern pine type. VI. Southern bottomlands. VII. Southern hardwoods. VIII. Pinon-juniper type. IX. Chapparal. X. Western yellow pine type. XI. Lodgepole pine type. XII. Engelmann spruce type. XIII. Silver pine type. XIV. Sugar pine type. XV. Redwood type. XVI. Sequoia type. XVII. Douglas fir type. XVIII. Alaska. XIX. Porto Rico. XX. Philippines. XXI. Timber valuation. XXII. Land valuation. XXIII. Titles. XXIV. Outline for a report.

Practical Least Squares. By Ora M. Leland. McGraw-Hill Book Co., New York. 237 pp., ill. For sale by 'Mining and Scientific Press'. Price, $3.

This book is intended as a text for short courses in engineering colleges, and as a reference book for the use of engineers and scientists. After a general introduction that is devoted to a consideration of the character and occurrence of errors, the adjustment of direct, indirect, and conditional observations is discussed in detail and illustrated by numerical applications to triangulation, leveling, astronomy, and the derivation of empirical formulas. Contents are as follows: I. Introduction. II. Direct observation of one quantity. III. Indirect observations of a function of the unknown quantities. IV. Solution of normal equations. V. Observations of dependent quantities; conditioned observations. VI. Adjustment of triangulation. VII. Empirical formulas. VIII. Precision of observations; results and combination of computed quantities. IX. Conclusion.

Recent Publications

The Microscopic Determination of the Nonopaque Minerals. By Esper S. Larsen. Bull. 679, U. S. Geological Survey, 1921. 294 pp., ill., index.

Secondary Metals in 1920. By J. P. Dunlop. I:10, U. S. Geological Survey, 1921. 15 pp. From Mineral Resources of the United States, 1920, Part I.

Testing Ores for Flotation. By A. W. Fahrenwald. Pamphlet No. 3, Bureau of Mines and Geology, State of Idaho, 1921. 22 pp., ill. University of Idaho, Moscow, Idaho.

Gas Masks for Gases Met in Fighting Fires. By Arno C. Fieldner, Sidney H. Katz, and Selwyne P. Kinney. Technical Paper 248, U. S. Bureau of Mines, 1921. 56 pp., ill.

Artificial Gas and By-Products in 1917-18. By R. S. McBride. II:33, U. S. Geological Survey, 1921. 62 pp. From Mineral Resources of the United States, 1919, Part II.

Differential Flotation. By A. W. Fahrenwald. Pamphlet No. 4, Bureau of Mines and Geology, State of Idaho, 1921. 23 pp., diagrams. University of Idaho, Moscow, Idaho.

Forty-Second Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior, for the Fiscal Year Ended June 30, 1921. 108 pp., index, map.

Seventeenth Report of the State Mineralogist. Mining in California During 1920. 562 pp., index, ill., maps. California State Mining Bureau, San Francisco, California, 1921.

The Round Mountain District, Nevada. By H. G. Ferguson. Bull. 725-I, U. S. Geological Survey, 1921. 24 pp. From Contributions to Economic Geology, 1921, Part I.

The Taylor Creek Tin Deposits, New Mexico. By J. M. Hill. Bull. 725-G, U. S. Geological Survey, 1921. 13 pp., map. From Contributions to Economic Geology, 1921, Part I.

Index to Mineral Resources of the United States, 1917. Part I—Metals. By H. D. McCaskey, Geologist in Charge, Division of Mineral Resources, U. S. Geological Survey, 1921. 20 pp.

Ore Deposits of Cedar Mountain, Mineral County, Nevada. By Adolph Knopf. Bull. 725-H, U. S. Geological Survey, 1921. 22 pp. From Contributions to Economic Geology, 1921, Part I.

Size of Mineral Particle in Relation to Flotation Concentration. By A. W. Fahrenwald. Pamphlet No. 2, Bureau of Mines and Geology, State of Idaho, 1921. 8 pp. University of Idaho, Moscow, Idaho, 1921.

Interfacial Tension Measurements and Some Applications to Flotation. By Robert B. Elder. Pamphlet No. 1, Bureau of Mines and Geology, State of Idaho, 1921. 33 pp., ill. University of Idaho, Moscow, Idaho.

Gold, Silver, Copper, and Lead in South Dakota and Wyoming in 1920. Mines Report. By C. W. Henderson. I:12, U. S. Geological Survey, 1921. 6 pp. From Mineral Resources of the United States, 1920, Part I.

Gold, Silver, Copper, Lead, and Zinc in California and Oregon in 1920. Mines Report. By Charles G. Yale. I:13, U. S. Geological Survey, 1921. 37 pp. From Mineral Resources of the United States, 1920, Part I.

Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1919. Mines Report. By Charles W. Henderson. I:27, U. S. Geological Survey, 1921. 15 pp. From Mineral Resources of the United States, 1919, Part I.

Silver, Copper, Lead, and Zinc in the Central States in 1920. Mines Report. By J. P. Dunlop and F. Begeman. I:11, U. S. Geological Survey, 1921. 48 pp. From Mineral Resources of the United States, 1920, Part I.

Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1919. Mines Report. By Frank L. Hess. I:26, U. S. Geological Survey, 1921. 19 pp. From Mineral Resources of the United States, 1919, Part I.

REVIEW OF MINING

SOUTHERN CALIFORNIA SECTION OF THE INSTITUTE DISCUSSES SILVER

The regular meeting of the Southern California Section of the Institute was held on Friday evening, February 10, at Los Angeles, being preceded by a dinner. Seeley W. Mudd led the discussion of the evening, the topic being 'Silver, with Special Reference to Mining and Metallurgy'.

HECLA-BUNKER HILL CONTRACT FOR PURCHASE OF STAR MINE IN THE COEUR D'ALENE HELD TO BE VALID—INJUNCTION DISSOLVED

Judge W. A. Huneke ruled, at Spokane, Washington, on February 1, that the contract between the Bunker Hill and the Hecla Mining companies wherein it is agreed to purchase, develop, and operate, as partners, the Star mine in the Coeur d'Alene region of Idaho, is valid. The decision followed eight days of legal arguments in respect to the validity of the Star purchase-contract, which was attacked by the Day-Smith interests. On every point brought out in the arguments of the last eight days, Judge Huneke ruled in favor of the Bunker Hill and Hecla companies.

On the question of whether the Helca could own stock in the Sullivan company, Judge Huneke said he had reached the conclusion that the amendments to the laws of Washington in 1905 gave this power to the Hecla, even though such a power was not included in the Hecla articles of incorporation. In this case, he said, the power to own stock was only an incident to the purpose of the Helca, which was to engage in the mining business.

In regard to the voting proxies agreement contained in the contract, Judge Huneke said, that under the plan for equal ownership of the Star mine, it would be the only arrangement possible to prevent a deadlock, and it was for that reason commendable in that it provided for the harmonious operation of the mine.

In regard to the point brought out by the plaintiffs, that the contract took away from the Hecla control of its property, Judge Huneke said: "The scheme does not interfere with the corporate activities of either the Bunker Hill or Hecla companies. The Sullivan company is a separate entity and, under this plan, the Hecla operations will not be interfered with".

To the objection of the plaintiffs that the contract would be in existence after the Hecla's corporate life expired, Judge Huneke said: "By the testimony already introduced, it appears to me that the Star mine will be worked out before the Hecla's life ends. If not, under Supreme Court decesions cited it will be possible to make some arrangements to handle this contract after the Hecla's life expires".

In closing, Judge Huneke said: "I have an abiding conviction that this contract is valid, legal, and altogether commendable. It is clear to me that the Hecla and Bunker Hill companies have the right to embark in this enterprise as joint adventurers and that the contract does not call for an illegal partnership". Before the argument was started, the plaintiffs reserved the right to introduce further testimony on the question of fraud and negligence in the event that they were unsuccessful. On February 2 the case came to a sudden ending when counsel for the Day-Smith people announced that his side would rest its case and appeal to the State Supreme Court on the single question of legality of the contract. The plaintiff abandoned completely all allegations in the complaint dealing with the question of fraud or negligence on the part of the Hecla directors and with the value of the Star mine.

A motion was entered to dissolve the temporary restraining order; it was granted. The Court then granted motions to expunge from the record all testimony claiming to prove fraud or negligence by the Hecla directors and all testimony introduced to prove the mine is not a valuable one.

"We regard the outcome of the trial as a complete vindication of our action in purchasing the Star", said James F. McCarthy, president of the Hecla. "The withdrawal of all charges of fraud and negligence and all allegations that the Star is not worth the money we are paying for it, before we had submitted any evidence at all, points to nothing other than the fact that these charges are not supportable.

"It was a little disappointing to have the trial end just as it did, because we were prepared and we would have welcomed an opportunity to prove that the Star is one of the finest orebodies left in the whole Coeur d'Alene district.

"We shall hold a stockholders' ratification meeting at an early date and proceed to fulfill our contract with the Bunker Hill. The work on the cross-cut from the Hecla shaft, by which we will tap the Star orebody, has been going steadily on and has now been extended nearly 2000 ft. The cross-cut is to be 8000 ft. long and it will take us about two years to complete."

F. W. Bradley, president of the Bunker Hill company, said:

"We are highly gratified at the outcome of the trial, and especially because it so completely clears every one of any suspicion of mismanagement or carelessness.

"At the Bunker Hill we contemplate the erection of an electrolytic plant to treat the Star ores. It isn't necessary, as we can contract for this work at Anaconda, but we believe we can save the Sullivan company about $3 per ton for freight by doing the work at Kellogg.

"We believe the future of the Coeur d'Alene country is in large tonnages of comparatively low-grade ores and we are preparing to treat ores that must be ground even to 200 mesh to be amenable to selective flotation.

"We have the processes now and when we have installed the equipment necessary we will give opportunity to a lot of mines and prospects in the Pine creek district to operate. There is a large amount of low-grade ore in that section that cannot be mined economically with present methods of making concentrate."

ANACONDA COMPANY PLANS TO PRODUCE 185,000,000 POUNDS OF COPPER AND 100,000,000 POUNDS OF ZINC DURING 1922

In the application of the Anaconda Copper company to the New York Stock Exchange to list additional stock, C. F. Kelley, the president, estimated the copper production for 1922 at 185,000,000 lb., zinc at 100,000,000 lb., lead at 30,000,000 lb., and silver at 6,750,000 ob. Regarding the Andes Exploration Co., Kelley says it is estimated the mines have 20,000,000 tons of 1.92% copper ore. Developments and operations at that property have been greatly curtailed during the last 15 months, but will be resumed on an enlarged scale as soon as greater copper production is demanded. Regarding the Arizona Oil Co., in which Anaconda owns 50% of the outstanding share capital, Kelley says the property consists of 160 acres of oil-producing land in the Bakersfield district of California, which has yielded from date of acquisition to October 1921, 1,386,000 bbl. of oil. Current production averages 33,000 bbl. per month. The company to date has 68 producing wells. The Anaconda Lead Products Co., which produces white lead, red lead, and other lead products by electrolytic process through an osmotic diaphragm, is now producing 18 to 20 tons of white lead per day, and has established a new standard for whiteness in white lead.

INFLUX OF MINERS TO MICHIGAN COPPER REGION

Many former residents of the 'Copper Country', accompanied by their families, are returning to Houghton from the industrial districts of Michigan and Wisconsin, where they went during the past year. The announcement that the Calumet & Hecla mines would resume production about April 1 is the magnet that has brought these people back but their return has been accelerated by the fact that industrial conditions in the manufacturing towns are in many cases bad. The returning former residents say they are the advance guard of a much larger movement which may be expected later in the year. Return of former workmen will be of great assistance to the mining companies that will have to re-build their organizations. On a basis of normal operations, there is a labor shortage in the district and none of the mines planning to resume in the spring could start with normal forces if they wished. There is no intention, however, to produce at capacity for several months after hoisting begins so the available labor will be sufficient for re-opening.

EAST BUTTE COMPANY WILL OPERATE DIVES-PELICAN MINES PENDING FINAL DECISION AS TO PURCHASE

The East Butte Copper Mining Co. paid slightly less than $500,000 for its recently acquired Dives-Pelican group of silver mines near Georgetown, Colorado. These properties are situated about 60 miles west of Denver, and from the time operations were started in 1870, the owners extracted from $8,000,000 to $15,000,000 worth of ore. When these mines were first operated, oil-flotation and more modern methods of concentration and treatment were unknown. The recovery by the first owners did not average more than 40% of the metal content of the ore, compared with 85 to 90% under present-day methods. At that time only ore averaging 12 oz. silver per ton or above was treated. There is consequently on the dumps today a very large quantity of ore that is considered now high-grade product, and with oil-flotation the waste material of other years can be made highly profitable. From the ore in sight, in the mines and on the dumps, East Butte estimates there is enough silver to pay for the whole cost of the mines. The first payment to be made in cash is one of 5%, and the balance is spread over a number of years, dependent upon the amount of ore produced. For the last two months East Butte has been running a 100-ton mill on test-work and the assays and yields are such that a 500-ton per day mill is in process of erection. It is estimated this mill be be operating at capacity by the first of April and will yield a profit of between $1.50 to $2 per ton of ore, or between $20,000 and $25,000 net monthly. The whole plan is virtually one of option—the first payment being less than $25,000—and East Butte can abandon the enterprise at any time without entanglements, but it is believed the mines will be a source of steady earnings, based on what has been shown to date.

OREGON SECTION OF A. I. M. & M. E. FAVORS PROPOSED MINING ACT, WITH RESERVATIONS

At the second annual meeting of the Oregon Section of the A. I. M. & M. E., held at Portland on January 28, H. M. Parks was elected chairman and P. R. Hines secretary. The following resolution was passed:

"The Oregon Section of the A. I. M. & M. E. is in favor of revising and codifying the present mining laws of the United States and is in accord with the principles of H. R. 7736 and the abolishment of the apex law and extralateral rights, but we wish to call attention to the following objections:

"Provision should be made for acquiring mineral rights on such withdrawals of public land as would not be injuriously affected thereby, and for the use of so much surface as might be found necessary under regulations made by the head of the Department having charge of such reservations.

"The location and holding of mining claims on which no discovery has been made should not be authorized on the same terms with claims having a discovery, but exclusive prospecting permits might be properly authorized upon a showing of probability that hidden deposits of ore exist at depth, such permits to be followed by location after the actual discovery has been made.

"Verification of discovery provided for in Sec. 5 should not be intrusted to Deputy Mineral Surveyors or other officers unless they have proven themselves to be qualified to judge the value of mineral deposits.

"The officer appointed to verify the discovery should not be required to accept evidence unless he believes that a discovery has actually been made. He should be given discretion to judge the credibility of witnesses. The word 'competent' should be added prior to the word 'persons' at beginning of line 6, page 5, and the word 'shall', line 8, page 5, should be changed to 'may' so the sentence may read:

" 'If discovery of a valuable mineral be made by drilling more than 100 ft. in depth, affidavits by at least two competent persons thoroughly acquainted with the facts, setting forth the nature of the discovery and the place, depth, and time at which it was made, may be accepted, etc.'

"The provision that one discovery shall be sufficient for 160 acres unduly restricts the opportunities of others and offers too many opportunities for acquiring lands desired for other purposes under the cloak of mining laws.

"The provision requiring patent within seven years will work hardship on the poor prospector who must develop a group by his own labor and earn his living by outside employment at the same time.

"The form of location notice should be prescribed by the Commissioner of the General Land Office rather than the Surveyor General in order that the procedure may be uniform in all States.

"It should be more clearly provided that a claim becomes 'void' rather than 'voidable' as at present in the event of failure to perform annual assessment work.

"The words 'during which location of claim be made', line 6, page 10, appear superfluous.

"The last proviso of Par. E, Sec. 6, appears superfluous and unreasonable.

"The language of the present statute should be followed in line 5, page 19, and also in line 17, same page, relative to mill-sites.

"Provision should be made for easement for right-of-way for tunnels to reach mineral deposits or for drainage purposes from without the claims.

"Provision should be made for recording proof of labor, and this record should be compulsory.

"The Section believes that the provision for claims to be located by legal sub-divisions or on cardinal lines is inadvisable."

JIB MINE AT BASIN, MONTANA, IS RE-OPENED

The old Jib mine situated at Basin, 23 miles north-east of Butte, Montana, has been re-opened. The Jib property is a consolidation of the Katie, Hope, and Atlantic mines, of which the Hope is probably the best known on account of its past production. About $2,000,000 worth of ore had been mined from above the 300-ft. level, prior to 1898, since which time little work has been done. Robert W. Shingle, of Honolulu, and associates in San Francisco who through Joseph Pheby obtained an option on the controlling interest in the Jib company will unwater the mine and thoroughly check the sampling of engineers who examined the mine when it was in operation. Among the men who have given favorable reports on the property are A. A. Blow, R. M. Atwater, Wm. G. Nebeker, Arthur L. Pierce, E. Maltby Shipp, and John C. Adams. Aside from the value of the ore developed in the upper levels the chief interest in the property centres in the remarkable possibilities of opening rich copper ore below the present workings. In his report on the geology of the property A. A. Blow said: "The veins in the Basin district are in the continuation of the same mineral belt as the Butte mines, and it is a fair geological inference that these lodes will undergo the same enrichment in copper which has developed at depth of from 1000 to 2400 ft. in the Butte mines . . ." The company enjoys many economic advantages. The Great Northern railroad passes through the property as does also the high-tension power-transmission line of the Montana Power Co. It also owns adequate water rights. Mine equipment includes hoists, compressors, motors, pumps, air-drills, cars; in fact everything is ready for the immediate resumption of production. If the sampling proves satisfactory funds are available for the erection of a 600-ton flotation plant for the treatment of the ore which has been proved to be amenable to flotation concentration. Ore in the upper levels is most valuable for its gold and silver content.

Surface Plant of the Jib Mining Company, at Basin, Montana

ARIZONA

Chapparall.—The owners of the Union mine are engaged in preliminary work of installing a flotation-plant of 100-ton capacity. An Allis-Chalmers ball-mill, Wilfley tables, and K & K flotation machines will be the equipment. The ore carries gold, silver, and some lead. Heavy snow has delayed work on the mill and hauling of the machinery.

Dos Cabezas.—The Elma shaft of the Central Copper Co., which is being sunk to the 1000-ft. level, is now down 300 ft. and stations are being cut at the 300-ft. and 200-ft. levels. A new orebody was cut recently on the 300-ft. level of the Consolidated workings.——It is reported that the Silver Camp group of claims has changed hands and the new owners have already commenced operations. The Silver Camp is one of the oldest locations in the district, high-grade silver ore having been taken out in the early days.——F. H. Huntsman has secured judgment by default against the Dos Cabezas Gold Ridge Mining Co. for the sum of $44,571. This property is one of the most extensively developed gold properties of the Dos Cabezas district. A 200-ton mill has recently been erected at the mine.

Holbrook.—It is reported that the Bethlehem Steel Co. has bonded 42 claims containing iron ore owned by William Bostwich and others in the Canyon Creek district for $150,000. Several months ago the Colorado Fuel & Iron Co. was reported as having secured leases and options on a considerable acreage bearing iron ore. This area is a considerable distance from transportation but offers inducements on account of the size and the grade of the iron ore.

Humboldt.—The Arizona National company has sunk a winze 200 ft. below the 200-ft. level, at a point 600 ft. from its main shaft, and has started drifting. The winze is in ore all the way and shows two feet of silver-lead ore that will average 20 oz. The flotation-plant has been idle since December, but will be started as soon as some changes and repair work has been finished. This mine has produced over $250,000 in silver; it adjoins the old Silver-Belt mine. Ed. Hill is superintendent and D. M. Reck mill-foreman.——Harkness & Kranz, lessees of the Lookout mine, are installing a flotation-plant of 50-ton capacity and re-timbering the old shaft. A shaft was sunk about 500 ft. south of the old workings and the result warranted putting these workings in order and moving the hoist. Six inches of solid galena is exposed in the old shaft. The ore assays over 60 oz. silver.

Oatman.—The January statement of the United Eastern Mining Co. shows that the company during the year milled 97,413 tons of ore having a gross value of $1,973,601. Although not as yet announced, the net operating income for the year, as indicated from the first eleven months operations, will reach $1,148,000. During December more ore was milled than in any other month of the past year, the tonnage having averaged slightly in excess of 300 tons per day. It has been officially announced that the company has purchased a controlling interest in the El Tigre group of gold claims in the State of Nayarite on the west coast of Mexico.——High-grade ore has been found by Messrs. Stoney and Ferra, lessees of the Ben Harrison claim of the Tom Reed Gold Mining Co. The vein carrying the rich ore, which assayed as high as $27,000 and averages $200 per ton across 18 in. of vein matter, was opened by means of a surface cut. A large amount of rich ore has been sacked for shipment and the low-grade ore is to be milled at the Tom Reed mill. Although rich pockets are not of frequent occurrence in the Oatman district, pockets of rich gold ore have been found near the surface.

Diamond-drilling operations at the Oatman United mine confirm results obtained heretofore. The orebody recently discovered now appears to be large, the last drill-hole having passed through 20 ft. of ground averaging $12 per ton in gold. It is claimed that 18 drill-holes have been put in to date at the 600-ft. level and these holes indicate an orebody that extends 300 ft. above and a considerable distance below the 600-ft. level. This strike has revealed ore to be present in the rhyolite; this heretofore has been considered barren rock in the Oatman district.

CALIFORNIA

Alleghany.—The Brush Creek quartz mine, near Mountain House, is to be re-opened this spring, according to announcement made by the promoters of the Kate Hardy group of mines at Forest, where a notable success in both mining and milling is being achieved. It is stated that approximately $150,000 is to be expended in the re-opening of the property.

Grass Valley.—Ore of milling grade is coming from the new shoot in the hanging wall of the South Star mine in the Dead Man's Flat district. The hanging-wall shoot is approximately four feet in width, the gold being free. An old and first-class shaft was discovered while another shaft was being sunk at the South Star. For some reason it had been sealed and forgotten, but inquiry disclosed that it was driven about 50 years ago. The first 100 ft. has been cleaned out and repaired. It has been found also that the early miners left their underground chutes full of mill-ore, thus indicating that the mine was closed hurriedly for some unknown reason. In the course of the new development more than 100 tons of good mill-ore has been hoisted and placed on the dump. The plan for the present year calls for a modern hoisting-plant, compressor, power-drills, and suitable buildings. A. W. Johnson of San Francisco is at the head of the development project.

Mack Sennett and Edward Fatherstone, at the head of the syndicate that has acquired the Normandie-Dulmaine group, have made the final payment on the property. Albert Greenwald, one of the owners and the general manager, states that the work is progressing well. A shaft is to be sunk probably to a depth of 500 ft. Cross-cutting will be started from the present station at 100 feet.

Greenville.—Erection of machinery and houses, and repair of old tunnels for active development has been completed by the Madre Mines Co. in the Arcadia and Southern Eureka, two of the six mines, two miles from here, acquired last year by California and Hawaiian business men. These properties are accredited with having produced more than $1,000,000 from shallow workings in early days. Power-drills are ready to develop the Arcadia orebody and, as soon as weather conditions permit, another compressor plant will be built at the Southern Eureka.

Placerville.—Mining machinery has been hauled to the Dan Aiken ranch in the Good Hill district of El Dorado county by Wolf & Levy, who have ten men at work developing their mine there.

Redding.—The Shasta Zinc & Copper Co. has set a crew of 40 men at work at Bully Hill, building a refinery. The company operated its smelter last season and produced several carloads of zinc oxide, but the product was not sufficiently pure to command the best price. By adding a refinery, the zinc oxide can be made pure at a cost that will be slight as compared to the advanced price that the product may be sold for. It is predicted that the refinery will be completed in three months.

Sierra City.—Announcement has been made by California and Nevada mining men interested in the Roman group of claims that work will be started as soon as the weather conditions will permit. The property is near Sierra Butte mine, and is said to contain several veins. The property has been developed by a 1200-ft. tunnel, shallow shaft, and several open-cuts. Development work in this gold property has been under way for two years.

COLORADO

Cripple Creek.—The January output of the Cripple Creek district totaled 52,400 tons with an average value of $7.40 and gross-bullion value of $387,560. The low value was due to heavy tonnage treated at the Independence mill of the Portland Gold Mining Co. at Victor—32,800 tons of an average value of $3.45 per ton. The Golden Cycle mill at Colorado Springs treated the remaining 19,600 tons of ore averaging $14 per ton, or a total of $274,000.

Denver.—The Pactolus Gold Dredging Co., recently organized by Denver men, will operate the Tollinsville placer in Gilpin and Boulder counties this spring. A contract has been let for a dredge to be delivered early in May. The placer is situated on South Boulder creek, and tests conducted over a period of two years has shown results of from 50c. to $1 per cubic yard. It is estimated there are six million cubic yards in the placer.

Kokomo.—Thirty-five miners are engaged in development at the Michigan mine and two cars daily are shipped to the A. V. smelter. The force will be increased in the spring and production also. Shipments will be resumed this spring by the Kokomo Mining Co. operating the Pearl Consolidated group in the Consolidated Ten Mile mining district of Summit county.

Lake City.—A leasing block at the third level of the Hidden Treasure mine, one of the best known producers of ore in Hinsdale county, has been taken by C. G. Slocum, a well known San Juan operator, and operations are planned on an extensive scale.

Leadville.—The Canterbury Hill tunnel is now equipped with a power-line, the compressor has been installed, and the Leadville Mines Development Co. is making good headway with machine-drills. The adit is in about 800 ft. without penetrating solid formation.——The Yak tunnel experimental plant is nearing completion. Low-grade complex ores will be treated later by a combination of flotation, concentration, and jigging. The low-grade ore mined in the tunnel is a heavy sulphide carrying lead, zinc, copper, and low gold-silver content.——W. R. Bowden and associate lessees operating the Henriette in Big Stray Horse gulch are shipping 1000 tons of black iron ore to the Omaha smelter monthly. Prospecting for a better grade of ore is under way in the lower levels.——Fifty tons daily of lead ore is the production from the Izzard, Gnome, and Wall Street mines in South Evans gulch. The ore is treated at the A. V. smelter.——Lessees on the first to fourth levels of the Fanny Rawlins are shipping steadily to the smelter. The gold content of the ore is high.——The Down Town mines are again hoisting about 100 tons daily, a favorable rate having been secured from the smelter.——It is estimated there are at this time 1000 men employed in Lake County mines, and properties are starting up weekly.

Montezuma.—The tunnel-sheds and blacksmith-shop at the property of the St. John Mines, Ltd., of London, was totally destroyed by fire of unknown origin the night of January 27. No instructions have yet been received from across the water, but reconstruction is expected. The properties of the company are operated under lease.

Telluride.—Monthly shipments from the Ophir Loop aggregate 15 cars, 10 cars of concentrate was shipped by the Belmont-Wagner Co. operating the Alta group and the remainder by lessees on Ophir mines. The Matterhorn M. & M. Co. having acquired title to the properties of the Butterfly-Terrible Mining Co. in the Ophir Loop district, plans extensive operations this spring. The mill is to be overhauled and new equipment added.——The Valley View Leasing Co. is treating around 100 tons daily of ore from the San Bernardo property at Matterhorn at its new mill. The recovery is reported excellent and the plant a success.

IDAHO

Clark Fork.—The Lawrence mine, a silver-lead property, after being idle for more than a year, has been leased by Joe Reed, its former manager. He has a carload of concentrate containing 50% lead and some silver ready for shipment. The last car of ore shipped from this mine netted $5000.——The Clarinda mine in the same district is driving a tunnel toward a promising vein.

Coeur d'Alene.—New and valuable discoveries have been made in the drift on the 300-ft. level of the Lookout Mountain property in the Pine Creek district. The drift has been driven about 200 ft.; three predominating shoots of good material have been opened. A large tonnage of ore is now available at the mine for shipment to the smelter as soon as a 2000-ft. tramway can be completed. The company will undertake development of the orebody at an additional depth of 300 ft. below the No. 2 workings, by means of a cross-cut. This will give a vertical depth of 600 ft. beneath the No. 1 workings.

High-grade ore has been found by the Hecla Mining Co. in its Wide West claims, according to reports. The Wide West is part of the group of claims in the Tiger-Poorman group acquired by the Hecla from the Federal Mining & Smelting Co. in the settlement of litigation in 1921. The ore is a foot wide and was found in following a narrow stringer for 25 ft. The ore contains lead and silver.

The lower cross-cut adit on the property owned by the Jim Blaine Silver Syndicate has been advanced 275 ft., according to Harry Morrell, manager. The face of the cross-cut shows good 'mineralization'.

MICHIGAN

Houghton.—It is estimated that 8,650,000 lb. of refined copper was produced in the Lake district in January. This represents Calumet & Hecla, Copper Range, Quincy, Mohawk, and Wolverine refinery production. Calumet & Hecla still has a few furnaces in commission, engaged in smelting cupola blocks and cathodes from the electrolytic plant. The January output in the district was approximately 40% of normal. Rail-shipments of copper are only half the volume of those during the season of navigation. Metal going out now is only for emergency use. Metal shipments usually increase with the opening of navigation when a lake-rail rate of 49c. per 100 lb. prevails on copper as compared with the present all-rail rate to New England of 76 cents.

New Arcadian, which recently reached a depth of 1100 ft. in its New Baltic shaft, is now drifting north and south. The north drift is in the vein, in good milling ground which compares favorably with any yet opened by the shaft. This drift will be pushed a reasonable distance to prove the lode on that side of the shaft. All efforts will then be centred on the south side of the shaft where the drift will be pushed toward the New Arcadian shaft.

It is expected Seneca will be in readiness to resume sinking in Gratiot No. 2 shaft late in the spring. Work on the power-plant and the building that will house the new hoist will be started shortly and rails will be laid to the shaft as soon as snow leaves the ground. Work of repairing the shaft is proceeding and good progress is being made. Concrete for the shaft-collar has been poured and the shaft has been cleaned out and re-timbered to below the sixth level.

Seven Calumet & Hecla conglomerate shafts are receiving the attention of timbermen. There is much work to be done, as the ground in the lower workings has badly crushed in places. Good progress is being made in the cleaning-up process and the rock being taken out is being piled along the railroad sidings, to be shipped later to the mills. The removal of rock, straightening out of the skipways, re-timbering, and shaft repairs, will keep several hundred men busy for some time to come. Repairs in the Calumet & Hecla mills have not yet been started. It is expected, however, that this work will be given attention shortly.

UTAH

Bingham.—The Montana Bingham Mining Co. has reduced its operating force to one shift. The company now employs 35 men, as compared with 75 a few weeks ago. Production has been curtailed owing to the Garfield smelter having an over-supply of low-grade copper sulphide ore.

Directors of the Silver Shield Mining & Milling Co. have declared a dividend of 300,000 shares of Bingham-Galena Mining Co. stock, payable March 4. This stock is to be divided, share for share, among Silver Shield shareholders. The 300,000 shares represents the proceeds of the sale of the Silver Shield mine to the Bingham-Galena company. George N. Lawrence has resigned as secretary and treasurer for the company, and L. Butterworth was elected as his successor.

Eureka.—A new ore discovery was made recently by George Paxman and Mart Steele in the Golden Treasure claim of the Tintic Drain Tunnel Co. About 3 ft. of ore has been exposed, averaging around 30 oz. silver. Four cars have been shipped.

Shipments of ore for the week ending January 28 totaled 141 cars, as against 145 cars for the previous week. The Tintic Standard shipped 59 cars; Chief Consolidated, 35; Eagle & Blue Bell, 11; Victoria, 8; Colorado, 6; Iron Blossom, 6; Swansea, 4; Bullion Beck, 3; Centennial-Eureka, 3; Dragon, 3; Gemini, 2; Grand Central, 1.

A large orebody has been opened on the 1000-ft. level of the Tintic Standard mine, about 600 ft. south of No. 2 shaft, according to E. J. Raddatz, president of the company. Another promising showing has been exposed by a drift that is being run in a north-easterly direction from the 1100-ft. level to connect the No. 2 and No. 1 shafts. About 50% of the ore from the mine is being shipped direct to Salt Lake valley smelters; the remainder going to the mill at Warm Creek. About 200 tons of ore per day is being treated in the mill.

Ore shipments from the Grand Central mine have been curtailed during the past two weeks, owing to repairs to the tramway. Production has been maintained at about 150 tons per day, and several thousand tons have accumulated during the shut-down. About 115 lessees are now working in the mine.

Park City.—The two major development projects in the Silver King Coalition mine show highly gratifying results, according to M. J. Dailey, mine manager. The first is the development of the O'Brien ore-channel from the 110-ft. level; the other is on the 1450-ft. level, in what is known as the M. L. M. zone. About 75% of the ore production from the property has been coming from these two zones. A recent shipment from the M. L. M. zone, where the ore has been proved for a distance of 700 to 800 ft., averaged 0.8 oz. gold, 105 oz. silver, 27% lead, and 0.66% copper, or a smelter value of $152 per ton. Silver constitutes the main value in this zone. On the 1300-ft. level, a drift has been sent out to develop the territory beneath the Crescent stopes. The company's new concentrator will be ready for operation on March 1.

Ore shipments for the week ending January 28 totaled 2049 tons, of which the Silver King Coalition shipped 816; Judge allied companies, 798; and the Ontario, 435. Shipments the previous week totaled 2024 tons.

The management of the Judge allied companies has decided to electrify the Ontario drain-tunnel, used principally by the Park-Utah Co., for the purpose of facilitating the handling of ore and supplies. It is expected that three months will be required to complete this work. Under present conditions, operations at the Park-Utah are much hampered owing to inadequate transportation through the tunnel.

WASHINGTON

Chewelah.—The United Silver-Copper Mining Co. whose mine is 4½ miles from here, elected the following board of directors at the annual meeting in its Spokane office recently: E. C. Blanchard, president; G. E. Merrill, vice-president; E. A. Wolfle, general manager; and P. A. Brady, superintendent. M. E. Poole was re-elected secretary-treasurer. In 1921 the company shipped 1335 tons of ore, containing 68,538 oz. silver, 253,781 lb. copper, and a small quantity of gold. The gross value of the silver was $66,885, copper, $21,734, and gold, $79, a total of $88,699. Treatment cost $6505, freight, $9513, and tax, $269, a total of $16,287. This shows net returns of $72,411. Production is expected to be increased during 1922.

Curlew.—Three groups of mining claims, 24 in all, on the Kettle river, have been conoslidated to form the New York-Boston Mines Co. A. M. Nash is engineer and managing director for the new company. The three groups are the Boston-New York, the American-Granby, and the National Silver-Lead mines. The mouth of the main tunnel, which is now in 1050 ft., is only 600 ft. from the Great Northern railway tracks. The tunnel extended to 4000 ft. will cut all of the veins on the property. Two veins of mill-ore are already cut by the tunnel and the next 700 ft. will cut three more. There has been done 2500 ft. of work on the several claims. In the lower tunnel is four feet of lead-silver ore, averaging $25. The property is equipped with a three-drill compressor, 50-hp. boiler, and other necessary equipment, tools, and buildings.

Spokane.—Preparations are completed for the 27th annual convention of the Northwest Mining Association, to be held here from February 14 to 18, according to Frank C. Bailey, secretary. Wednesday will be Washington day, and will be occupied in organization and committee work. Professor Frank M. Handy, formerly of the Washington State College, will talk on the mineral resources of the State. J. C. Haas, mining engineer and operator, will talk on iron production and manufacture. In the evening a 12-reel film on 'Copper Mining in Montana' will be presented. This picture is owned by the Government and said to be the greatest of its kind ever shown. Days for Idaho, British Columbia, and Oregon will follow.

Republic.—J. E. Dailey who paid $25,000 cash recently for the Knob Hill mine near here, reports that he bought it for a Los Angeles syndicate, headed by L. E. Barker and that the syndicate within 90 days will begin development.

WISCONSIN

Cuba City.—The Zinc Hill Co. and the Connecting Link Mining Co. were large shippers of low-grade zinc ore to the National Separating Co., over the entire month of January regardless of weather and the condition of roadways. Both also shipped lead ore to the Federal Lead Co. Experiments at the laboratories of the National Separating Co. have been completed, and additions will be built to the works, with accruing advantages to the mining men of this field.

Madison.—George J. Barker, an instructor in mining and metallurgy in the College of Mechanics and Engineering, at the University of Wisconsin, is carrying on research in the leaching of zinc ores and the production of electrolytic zinc from the leach-solution. The experiments conducted so far have been successful in showing a high leaching-recovery. Zinc-mine operators have been co-operating with Barker, and samples have been taken from nearly all the important mines in the Wisconsin field.

Platteville.—The improved condition of the lead-ore market, especially over the latter half of the month of January, was responsible for more mining operations. Most producers are removed considerable distances from the railways, and haulage is performed by motor-truck or by team. The Federal Lead Co. asked for a quota of at least 1000 tons of ore, with offerings of $60 per ton, base price. On this basis some milled lead ore was obtained that brought the top price paid for the month to $62.50 per ton. The present price of lead ore enables the miner to sell and ship at a profit, labor being obtainable at reduced scales. Prospecting for lead ore has increased in the Galena and Cuba City districts.

The zinc-ore market was not so brisk, a declining metal market causing a sympathetic fluctuation in the price of ore. Some high-grade blende was sold from separating plants to the United Zinc Smelters but the tonnage was not great. A better demand, however, for the crude zinc concentrate from mills was noticeable and the mines producing low-grade zinc concentrate shipped liberally all month, although the prices paid for the various grades offered were discouraging.

For the first time in a year buyers evinced an interest in carbonate-zinc ore, termed locally 'dry-bone'. The Mineral Point Zinc Co. has invariably held this market unmolested, and offerings have been usually fair, but miners have been seeking an outlet and outside interests sent a buyer into the field who acquired samples for assay. The Mineral Point Zinc Co. laid offerings on samples taken and assays previouly submitted of $12.50 per ton, basis 30% zinc content. As most of the ore offered will test closer to 40% zinc, and the unit rise is about 60c., the higher grades would bring about $18 per ton, less the usual penalties for iron, lime, lead, and moisture.

The Block-House Mining Co. shut-down a year ago, but in the interval the owners erected a second zinc concentrator of 200 tons capacity. The Enterprise Separating Works, long idle, also was taken over and a force of men put to work to arrange the plant for active ore treatment. About 1200 tons of low-grade zinc concentrate held at the Block-House mine will be taken to this separating plant for refining.

Shullsburg.—The Pacquette Mining Co. has a new mine producing rich lead ore and fair zinc ore. Some time ago two cars of high-grade zinc ore were sold and now the Pacquette mine is shipping high-grade lead ore.——The Rodhams Mining Co. opened a new vein of lead ore recently and recoveries are now of sufficient volume to afford shipments of car lots of high-grade lead ore.

ALBERTA

Edmonton.—At the general meeting of the Imperial Oil Co., held in Toronto on January 19, Victor Ross, vice-president, reporting for the production department in the West, stated that the well at Pouce Coupé had a flow of 10,000,000 cu. ft. of gas daily, but that no use was being made of it, owing to its remoteness from civilization. Drilling was being continued in the hope of finding oil. The company had abandoned operations at four wells, but were still operating at 14 other points, besides Fort Norman. Some of the prospects were promising. The deepest well that had been abandoned was Twin Butte, in southern Alberta, which had reached a depth of 3975 ft. It was not expected that anything further would be heard from Fort Norman until the spring, and it might be years before any definite results were obtained.

BRITISH COLUMBIA

New Denver.—The Standard mine, which had to suspend operations during the recent cold weather, on account of a shortage of water, has been re-started. Fully 1000 tons of ore has been accumulated in the bins, ready for the re-starting of the mill.——A. S. McCaulay and R. McFarlane, of Silverton, have shipped a carload of ore from the Metallic group, near the Galena Farm mine.

Prince Rupert.—Dale L. Pitt, manager for the Premier Gold Mining Co., passed through here recently, on his way to Salt Lake City. The Premier now is shipping 100 tons of ore per day by the new tramway; later, it plans to increase the tonnage to double that amount; it will also ship ore of a lower grade to the Granby company's smelter, at Anyox. In addition to the high-grade ore that is going to the Tacoma smelter, there is being shipped to Tacoma, 400 tons of concentrate monthly. This is obtained from the mill, which is treating 100 tons of ore daily. The tailing from the concentrator is ground finely and cyanided, and from the cyanide-plant precipitate is being shipped to the Selby smelter pending the completion of a melting-plant at the mine. The tramway, which is 11½ miles long, 10 miles being in Alaska, is the longest single-cable-drive tramway in the world. It has 153 towers, 3 angle-stations, and 12 tension-anchors. It is equipped with the latest devices known to tramway construction. The survey was made and the tramway built in 12 months. Pitt gave no information as to the relative value of the material shipped, but in the past little ore of a value below $150 per ton has been shipped, while the concentrate has been somewhat richer.

Quesnel.—The Construction Mining Co., which recently purchased the old Mathers property on Peters creek, a tributary of Lightning creek, has struck rich ground. The old overshot wheel, which has been idle for 12 years, has been brought into service again, and is providing all the power required at the mine.

Smithers.—The Steamship Mining Co., which has been developing a narrow rich vein on the King group, on Driftwood creek, 20 miles from here, has ceased work and wound up the affairs of the company. Though the vein gave assays ranging from 100 to 200 oz. in silver, about $4 in gold and 10% lead, it was thought that its size, ranging from a few inches to three feet, was so small that it could not be worked profitably.

Trail.—The ore received at the smelter for the week ended January 21 totaled 8631 tons, of which 8256 tons came from the company's mines. The other shippers were: Arlington, Slocan City, 5 tons; Bell, Beaverdell, 39; Knob Hill, Republic, 29; L. T., Slocan City, 6; Ottawa, Slocan City, 32; Paradise, Lake Windermere, 35; Roseberry-Surprise, Roseberry, 175; and Rambler-Cariboo, Rambler, 54.

Arthur Plant of the Utah Copper Co., at Garfield. Magna Mill in the Distance

MANITOBA

Elbow Lake.—Another important strike is reported to have been made in this field. Jacob Cook, a prospector employed by J. P. Gordon, reports having discovered a quartz vein 20 ft. wide carrying free gold some distance to the east and on the same contact as the original Murray discovery.

MEXICO

Chihuahua.—J. K. McQuaters, of the Alvarado Mining Co., and other American capitalists are said to be interested in the establishment of a new bank in the city of Chihuahua, for the purpose of financing irrigating projects from the Boquilla dam and installing hydro-electric power for general use at the mines and towns throughout the State. The organization is to have a capitalization of twenty million pesos.

Durango.—Ernest Stein has been named secretary of the Durango Mining Congress, recently organized in Durango City for the purpose of encouraging the mining industry of the State. The members will be men actively engaged or directly interested in mining, milling, or smelting. Offices have been established where an exhibit of minerals will be found and literature and general information can be procured.

Nacozari.—Three more carloads of silver ore have been shipped through Nacozari from the Las Chispas mine of Minas Pedrazzini Gold & Silver Mining Co., making a total of seven cars for the month; the net value was about $220,000.

ONTARIO

Cobalt.—On January 27, 14 tons of silver, the largest bullion shipment in the history of the district, left for New York en route for China. The Nipissing mine sent 403,000 ounces.

Kirkland Lake.—The annual report of the Teck-Hughes for the year ended August 31 shows earnings of $304,792 and total revenue of $344,806. The total expenditure was $291,956, leaving a net revenue of $52,850. During the year 32,634 tons of ore was treated with a recovery of $9.34 per ton, operating costs being $8.95 per ton. Ore-reserves were estimated at 98,890 tons of an average grade of $9.17 with a gross value of $907,140. A supplementary statement issued January 12 states that operations since September 1 had shown a net profit of approximately $10,000 per month, and that during December development on the sixth level had been so satisfactory that 2900 tons of ore had yielded a gross return of about $46,000, which should give some $25,000 net profits.

Porcupine.—Negotiations are in progress for the purchase by the Northern Canada Power Co. from the McIntyre-Porcupine of the right to develop electric power at Sturgeon Falls on the Mattagami river. This would enable the power company to develop 7000 hp. for the gold mines of the Porcupine district. The matter will not be finally settled until the action brought by the Hollinger Consolidated against the power company has been decided.——Walter H. Weed, of New York, who examined the Porcupine-Paymaster, has made a report recommending the expenditure of an additional $100,000 in development work, including the sinking of the shaft to a depth of 300 ft. and at least 1000 ft. of lateral work at that level.

Skead Township.—An exhaustive test of ore from one of the 50 locations of the Skead Gold Mines has been completed at the Government laboratories at Cobalt. The report shows gold content of $11.40 per ton and copper $10. During the last few months 22 new veins have been discovered on this portion of the company's holdings.

Obituary

Hubbard Wilkins Reed, for the past forty years a well-known and much-respected mining and civil engineer of Colorado and Utah, died at his home in Salt Lake City on January 30, after an illness of but a few hours. He was born in New York City on December 3, 1849. After graduating from Dartmouth College, he came West and was employed as civil engineer for several years in North Dakota on the construction of the Northern Pacific railroad. He then went to Mexico, but returned within a short time to the United States and settled at Ouray, Colorado, where he was manager for the Revenue Mining Co. for 30 years. At one time he owned part of the Camp Bird property, out of which Thomas J. Walsh made his fortune. In the early '90s he came to Utah, and acquired a substantial interest in the old Daly-West mine. Later he was vice-president of the old Consolidated Mercur mine at Mercur. For the past few years he has been vice-president and general manager of the Utah Fire Flay Co. at Salt Lake City. He is survived by one daughter. His death will be sad news to many.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Samuel W. Cohen, of Montreal, was in San Francisco last week.

J. K. Turner has returned from New York to Goldfield, Nevada.

Lester W. Strauss has returned to Valparaiso from Bolivia.

Douglas G. H. Wright is now with the Dome Mines company, Ontario, Canada.

B. Prescott is making geological studies in the Sierra Mojada district, Mexico.

R. G. Hall, who returned recently from Namtu, in Burma, is temporarily at St. Louis.

Louis A. Wright, formerly of New York, has arrived in San Francisco from Los Angeles.

C. L. Palmer is now with the Hollinger Gold Mines company, at Timmins, Ontario, Canada.

Dale L. Pitt, manager of the Premier mine, in British Columbia, was in San Francisco this week.

K. F. Klein sailed from New York for Maracaibo, Venezuela, where he will be with the British Equatorial Oil Co.

Charles B. Croner is examining properties in the Goldstrike district, south-east of Modena, Utah, for Eastern capital.

H. G. S. Anderson, assistant general manager of the Chino Copper Co., has returned from New York to Hurley, New Mexico.

Samuel H. Dolbear left New York for Quebec late in January. He expects to visit Ontario before returning to New York.

S. Herbert Williams, general manager for the Boston & Ely Consolidated Mining Co., is on his way from Nevada to New York.

James R. Finlay has completed his valuation of the mines of New Mexico for the purpose of taxation. He has returned to Los Angeles.

George W. Lambourne, president of the Judge allied companies at Park City, Utah, has returned to Salt Lake City from New York.

Arthur W. Jenks returned last week from an extended trip in Northern Ontario where he has been examining mining properties for New York clients.

Morris B. Parker, of Hollywood, California, left last week for a trip into Sonora, Mexico, to make examinations of the San Jose mining properties near Nacozari.

Gomer P. Jones, general manager for the Hedley Gold Mining Co., passed through San Francisco on his return from Los Angeles to Hedley, British Columbia.

Roscoe Wheeler, who has been living at Berkeley, is returning to Hedley, B. C., as mill superintendent to the Hedley Gold Mining Co., which is resuming operations.

V. H. Peerman passed through San Francisco this week on his way to Aguascalientes, where he will take charge of the blast-furnace department at the A. S. & R. smelter.

Arthur L. Tuttle, of the Tennessee Copper Co., has arrived in Mexico from New York. He is interested in a number of mines at Jimulco, Los Reyes, and other places near Torreon.

S. F. Shaw is now manager for the Cia. Minera la Constancia and superintendent of the properties controlled by the Cia. Minera de Peñoles, in the Sierra Mojada district of Mexico.

Hugh M. Benton, formerly instructor in metallurgy at the Case School of Applied Science, has entered private practice as a consulting mining and metallurgical engineer, with headquarters at the National City building, Cleveland, Ohio.

THE METAL MARKET

METAL PRICES

San Francisco, February 7

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	14.25—14.75
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$95
Platinum, 10% iridium, per ounce	$105
Zinc, slab, cents per pound	6.50—7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

February 6.—Copper is dull and easier. Lead is quiet and steady. Zinc is inactive; no change.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Jan.	31	66.12½	35.25	Dec.	26	65.50	35.25
Feb.	1	66.37½	35.12½	Jan.	2	64.82	34.90
"	2	66.50	35.12½	"	9	64.90	34.83
"	3	66.62½	35.12½	"	16	66.06	35.31
"	4	66.50	34.75	"	23	65.27	34.90
"	5 Sunday			"	30	65.46	35.06
"	6	66.00	34.62½	Feb.	6	66.35	35.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	132.77	65.95	65.45	July	92.04	59.99	....
Feb.	131.27	59.55	....	Aug.	96.23	61.59	....
Mch.	125.70	56.08	....	Sept.	93.66	66.22	....
Apr.	119.56	59.33	....	Oct.	83.48	71.00	....
May	102.69	59.90	....	Nov.	77.73	68.24	....
June	90.84	58.51	....	Dec.	64.78	65.76	....

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Jan.	31	13.37½	Dec.	26	13.62
Feb.	1	13.37½	Jan.	2	13.62
"	2	13.25	"	9	13.56
"	3	13.25	"	16	13.62
"	4	13.25	"	23	13.54
"	5 Sunday		"	30	13.48
"	6	13.25	Feb.	6	13.29

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	19.25	12.94	13.54	July	19.00	12.46	....
Feb.	19.05	12.84	....	Aug.	19.00	11.71	....
Mch.	18.49	12.20	....	Sept.	18.75	12.03	....
Apr.	19.23	12.50	....	Oct.	16.53	12.66	....
May	19.05	12.74	....	Nov.	14.63	13.07	....
June	19.00	12.83	....	Dec.	13.18	13.54	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Jan.	31	4.70	Dec.	26	4.70
Feb.	1	4.70	Jan.	2	4.70
"	2	4.70	"	9	4.70
"	3	4.70	"	16	4.70
"	4	4.70	"	23	4.70
"	5 Sunday		"	30	4.70
"	6	4.70	Feb.	6	4.70

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	8.65	4.96	4.70	July	8.63	4.75	....
Feb.	8.88	4.54	....	Aug.	9.03	4.40	....
Mch.	9.22	4.06	....	Sept.	8.08	4.61	....
Apr.	8.78	4.32	....	Oct.	7.28	4.70	....
May	8.55	5.01	....	Nov.	6.37	4.70	....
June	8.43	4.57	....	Dec.	4.76	4.70	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	62.74	35.94	32.04	July	49.29	27.69	....
Feb.	59.87	32.16	....	Aug.	47.60	26.35	....
Mch.	61.92	28.87	....	Sept.	44.43	26.70	....
Apr.	62.17	30.36	....	Oct.	40.47	27.70	....
May	54.99	32.50	....	Nov.	36.97	28.93	....
June	48.33	29.39	....	Dec.	34.12	32.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Jan.	31	4.85	Dec.	26	5.23
Feb.	1	4.85	Jan.	2	5.17
"	2	4.85	"	9	5.16
"	3	4.85	"	16	5.11
"	4	4.85	"	23	5.04
"	5 Sunday		"	30	4.93
"	6	4.85	Feb.	6	4.85

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	9.56	5.86	5.05	July	8.18	4.41	....
Feb.	9.15	5.34	....	Aug.	8.31	4.69	....
Mch.	8.93	5.19	....	Sept.	7.84	4.74	....
Apr.	8.76	5.37	....	Oct.	7.50	5.09	....
May	8.07	5.37	....	Nov.	6.78	5.18	....
June	7.92	4.96	....	Dec.	6.03	5.24	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Jan.	10	50.00	Jan.	24	50.00
"	17	50.00	"	31	50.00
			Feb.	7	50.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	89.00	50.00	50.00	July	88.00	47.75	....
Feb.	81.00	48.75	....	Aug.	85.00	47.50	....
Mch.	87.00	45.88	....	Sept.	75.00	47.50	....
Apr.	100.00	46.00	....	Oct.	71.00	46.25	....
May	87.00	50.00	....	Nov.	56.00	40.40	....
June	85.00	49.50	....	Dec.	52.50	49.50	....

THE FEDERAL RESERVE BANK AND AGRICULTURAL 'BLOC'

"The attacks of the agricultural bloc in Congress upon the administration of the Federal Reserve System and the effort to obtain by legislation special recognition for the farmer interests in the personnel of the Federal Reserve Board constitute a grave menace to the services of the Federal Reserve System and, in consequence, a menace to the country's welfare", declares 'The Guaranty Survey'.

"While the proposed legislation in its most dangerous form, that of explicitly requiring the President to appoint a farmer to the Reserve Board, has been modified, the substitute, which has been passed by the Senate and which increases the membership of the Board on the reported understanding that a farmer will receive the appointment, does not disguise the purpose of the agricultural interests to secure special treatment.

"While there is validity in the contention of the farmers that the operation of economic forces at present reacts unfavorably on their position, it is clear that the course now being pursued in Congress will not only fail to alleviate the adverse situation but will render it more complex and difficult of correction. Any attempt in contravention of economic laws, in this case as regards money and credit in relation to the agriculturists, to secure the advantage of special interests must inevitably arouse false hopes and delay necessary readjustments in accordance with sound economic principles. Moreover, the placing of a 'dirt' farmer on the governing board of the national banking system cannot serve the agriculturists as a medium for solving their problems.

"The present class agitation in many respects is not unlike that which developed during the agrarian movement which was initiated soon after the Civil War and which culminated in the 'nineties, with attempts to force a 'sufficient' issue of Government paper money, the abolition of national banks, and a revision of the tariff dictated by narrow class interests. In a period in which economic forces are unsettled and are seeking to find proper relationships, a lack of understanding of the fundamental elements in the situation is not uncommon. A concerted movement based on a misconception of the causes and the remedies for such a situation oftentimes may gain considerable headway and result in unsound legislation before its dangers are realized and corrective action is undertaken. The experience of the past should teach the farmers that their prosperity cannot be effected apart from the readjustment which the whole world is striving for and that it can be restored only when the causes of the general maladjustment are recognized and means found to eliminate them.

"The full effectiveness of a great banking system like ours can be preserved only if it is administered in behalf of the common good, not of class interests. The immediate problem that concerns the preservation of the Federal Reserve System unhampered by selfish motives, is best summed up in the Advisory Council's statement of the cardinal principles of the Federal Reserve System. These are that the System should, first, maintain its character as a reserve system and keep its assets 'safe and liquid'; and, second, the independence of the Board must be 'strengthened and protected' by obtaining the services of men of the highest intelligence and integrity, free from political or other selfish influences."

MONEY AND EXCHANGE

Foreign quotations on February 7 are as follows:

Sterling, dollars:	Cable	4.35
	Demand	4.34½
Franc, cents:	Cable	8.49
	Demand	8.47
Lira, cents:	Demand	4.78
Mark, cent:		0.50

Eastern Metal Market

New York, February 1.

Extreme dullness pervades most of the markets; prices in some are lower.

Demand for copper is very small and quotations have declined.

The tin market is active one day and quiet the next.

Buying of lead continues steady at firm prices.

There is no life to the zinc market and prices have again fallen.

Antimony is lower.

IRON AND STEEL

As January ends, the amount and character of new demand for steel products is somewhat better than at any time in the month. The larger amount of new construction work ahead, not omitting a better prospect here and there for shipyards, accounts in the main for the improvement, but there is also a healthy volume of replenishment buying. Chicago rather than Pittsburgh sees conditions in a more favorable light.

The Steel Corporation's statement for the last quarter of 1921, showing net earnings to be $1,700,000 greater than in the third quarter, reflects the 40% increase in output in the last quarter, with the offset of lower prices than the average for the third quarter, says 'The Iron Age'.

COPPER

It is definitely established that electrolytic copper can be obtained in fairly large quantities from some sellers as low as 13.37½c., refinery (or New York), and 13.62½c., delivered, for February and March. Most large producers refuse to quote less than 13.87½ to 14c., delivered, but there are evidently enough sellers, dealers, and small producers, willing to meet the lower prices and some fairly good business has been done. In any event the volume is not heavy, for consumers generally are well covered by their purchases last year and are specifying freely on their contracts. Buying for export is not as heavy as formerly, but is good. Lake copper is quoted at 13.62½c., delivered, in a quiet market.

TIN

Activity in the Straits tin market has been confined to one day, Thursday, January 26, when sales were brisk, estimates placing the total at 600 to 1000 tons, the latter figure probably being too high. On other days the market has been dull and quiet. In the one day referred to, dealers and importers were the largest purchasers although consumers also took a hand and all reasonable offerings were quickly absorbed. Buyers evidently considered that the liquidation by the Chinese of their metal before their new year, January 28, had spent itself and that it was a good time to enter the market. On the New York Metal Exchange 25 tons of Straits tin for May-June shipment was sold at 30.25c. on January 25 and also 50 tons for delivery in 1922 at seller's option at 30c. There was only a small advance in London on Friday following the activity here, but yesterday there was an advance of £2 per ton over Monday, with spot standard selling at £159 10s., future standard at £161 5s., and spot Straits at £161 10s., all about £1 per ton higher than a week ago. Arrivals thus far this month have been 3910 tons, of which only 75 tons came in through Pacific ports. Tin afloat on January 30 is reported as 7035 tons.

LEAD

Fundamental conditions are unchanged. Demand continues steady and fully equal to production, with prices firm and steady at 4.70c., New York and St. Louis, asked by the leading interest, and at 4.40c., St. Louis; and 4.70 to 4.75c., New York and Eastern points, is asked by independents. Unless production is augmented in the near future, some think the metal will be scarce and higher.

ZINC

Absolute stagnation characterizes this market. As a consequence offerings from weak hands or from sellers desiring to do some business depressed values until prime Western for early or 30-day delivery is quoted at 4.50c., St. Louis, or 4.85c., New York, as contrasted with 4.65c., St. Louis, a week ago. Demand is confined to carload and 100-ton lots for early delivery to fill immediate needs, but even these are few in number. The London market is falling also and at about the same rate.

ANTIMONY

The market is dull and lower with wholesale lots for early delivery quoted at 4.40c. per pound, duty paid, New York.

ALUMINUM

There is no activity. The leading producer quotes virgin metal, 98 to 99% pure, at 19 to 19.10c. per pound, f.o.b. plant, in wholesale lots for early delivery, while the imported metal of the same grade is quoted at 17.50 to 18.50c., New York, duty paid.

ORES

Tungsten: Improvement, if any, is very slow. Some inquiry is reported but little business has been done. Scarcely any high-grade is being ordered and not much Chinese ore is available. Quotations are unchanged at $2 per unit and higher.

Molybdenum: There is no change in quotations which are nominal at 45 to 50c. per pound of MoS_2 in regular concentrates. No business is reported.

Manganese: Quotations for high-grade ore range from 22 to 25c. per unit, seaboard. There are offerings of Russian ore at 25c. per unit, seaboard, two cargoes of which are to sail, one of 5000 tons in February and 6000 tons in March, on which 23.50c. per unit was refused.

Chrome: The market is dull and devoid of interest with quotations nominal at $20 per net ton, c.i.f. Atlantic ports and higher.

FERRO-ALLOYS

Ferro-manganese: Carload and small lots in limited number continue to constitute the demand. Both British and domestic alloy is being sold to meet this demand and the Carnegie Steel Co. is now selling on a seaboard-basis quotation of $58.35.

Spiegeleisen: Business is confined to carload and small lots, sales having aggregated about 200 tons, all at $26, furnace, for the 19 to 21% material, and at $25 for the 16 to 19% alloy.

Ferro-tungsten: The market is devoid of any feature or activity and quotations continue nominal at 40 to 45c. per pound of contained tungsten, with the foreign product at 50c., duty paid, f.o.b. Atlantic ports.

Ferro-silicon: Sales of small and carload lots continue to constitute the active business which is being done at $55 to $60 per ton, delivered. One seller will not consider long-time contracts for 1922.

Ferro-chromium: Quotations continue nominal in a quiet dead market at 13 to 14c. per pound of contained chromium, delivered, depending on the carbon content, quality, etc.

Total purchases of domestic silver under the Pittman Act to date total about 90,000,000 ounces.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

IS THERE A CLASSIFYING ACTION WITHIN THE CONICAL MILL?

When the conical mill was first introduced in the mining industry several years ago, there was considerable discussion as to its merits. The principal claim for the conical shape then was, and now is, the classifying action of the grinding-media that occurs during the rotation of the mill.

Several prominent engineers have recently remarked that, in their opinion, no classifying action exists. The opinion of these engineers cannot be treated lightly, although it is reasonable to say that, not having any particular interest in the conical mill, it was not to their advantage to spend a great deal of time in close investigation of the facts. There must be many others of the same opinion, while others are positive that there is a condition within the mill which causes the large balls to remain at the greatest diameter and the smaller sizes in the cone. Both contentions cannot be right.

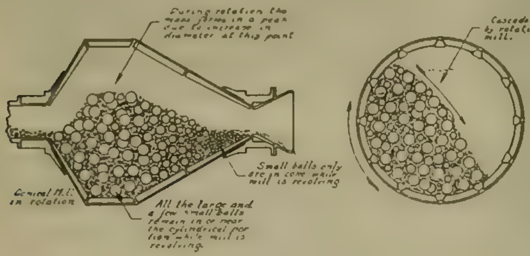
During rotation the mass forms in a peak due to increase in diameter at this point
Cascade caused by rotation of mill.
Small balls only are in cone while mill is revolving
Conical Mill in rotation
All the large and a few small balls remain in or near the cylindrical portion while mill is revolving.

Fig. 1

This article is written by one who is a firm believer in the classifying action of the conical mill, and facts are presented in an endeavor to substantiate this belief. Mr. Arthur H. Sancton, Canadian engineer for Fraser & Chalmers, Ltd., London, at the time the Hardinge mill first came upon the market, was instructed by his company to investigate the segregating feature of the conical mill. Upon request, he submitted a copy of the sketch similar to Fig. 2. His investigation covered the pebble-mill only, but it stands to reason that if the segregating action was shown in a pebble-mill, a similar action would be shown in a ball-mill, with the much heavier balls as grinding-media. This assumption has been verified by several unofficial investigations with the conical ball-mill.

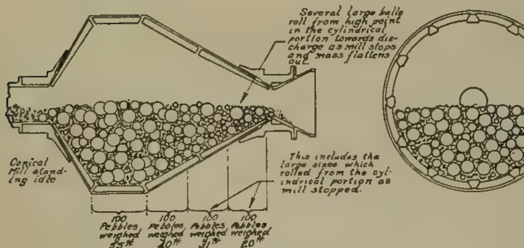
Several large balls roll from high point in the cylindrical portion towards discharge as mill stops and mass flattens out.
Conical Mill standing idle
This includes the large sizes which rolled from the cylindrical portion as mill stopped.
100 Pebbles weighed 55#
100 Pebbles weighed 40#
100 Pebbles weighed 31#
100 Pebbles weighed 20#

Fig. 2

The mill during rotation lifts the entire mass in the manner as shown in Fig. 1. This apparent pyramiding action is due to the differences in diameter of the mill. At the large diameter, the mass is raised higher from the axis of rotation than that mass near the discharge opening. This action exists, of course, only while the mill is rotating. When the mill is stopped, this stoppage occurs very rapidly—as everyone who has operated a ball-mill knows—the pyramiding action diminishes, and the mass within the mill takes the position as shown in Fig. 2. The large balls in the cylindrical portion, being at the highest point, scatter in all directions, some of them landing near the discharge, and before they have a chance to roll back down the cone, the mill has stopped and the mass catches these balls and prevents their further movement.

This is submitted as the reason why large balls are found at or near the discharge of the mill when opening up and inspecting the inside, but if anyone sufficiently interested would take the trouble to do as Mr. Sancton did, that is, shovel out a definite quantity of pebbles, or balls, as the case may be, irrespective of size, and then weigh them, he will find that even though there are a few large balls near the discharge, the ratio will be greatly in favor of the smaller sizes. Fig. 2 shows the actual results of the investigation made by Mr. Sancton.

Again, why shouldn't the large mill have a classifying action as well as the small models? A glass model 1¼ in. diam. gives identical results to the large glass models over a foot in diameter. This means a ratio of about 1:10; then why does not a mill of 8-ft. diam. give the same result as the model one foot in diameter, keeping the grinding media and material in the same ratio? No one can deny that the models show a segregating action. In actual operation, there is the incoming feed to take into account, but this should have no effect upon the classification of the relatively heavier grinding media.

It is the practice of most companies operating Hardinge mills to feed-in the large replacement balls or pebbles through the discharge-trunnion while the mill is in operation. A maximum ball-charge is shown when the mill discharges small balls. Carrying this point even further, several operators, desiring to change their ball-load to larger sizes, rather than dumping the mill and sorting out all sizes of balls, have added the larger-diameter balls while the mill was running. In one case in mind, in changing a ball-load of 2-in. diam. balls and smaller to a 4-in. ball-charge, 8 tons of 4-in. balls were fed into the mill through the discharge-trunnion and an equal number of small balls were forced out. The balls forced out were all approximately 1-in. diam., none being of the larger sizes. This shows that only the small balls were in the discharge-cone near the discharge-trunnion and that as soon as the large balls were thrown into the discharge-opening they rolled back to the large diameter.

The facts as presented in this discussion show that there is a positive classification of the grinding media in the conical mill, no attempt being made to explain why this classification occurs. If there is anyone who can present evidence which apparently contradicts the facts as given here, they are urged to submit them, for only by such discussion can disputed points be settled once and for all.

'DRYER' ENGINEERING

The art of drying materials has taken great strides during recent years. Among the engineers who have devoted much time to the development of methods and equipment is L. R. Christie, president of the L. R. Christie company of Pittsburgh, Pennsylvania. The company has recently issued a small booklet in which are described the principles of drying, and the methods and the machines needed in this work. Mr. Christie has discussed the subject of efficient drying in such a manner that the reader, be he engineer, plant-foreman, or investigator, will appreciate the points that must be considered in selecting a dryer.

A current of air will absorb moisture to a limited extent but it is necessary to have, in commercial practice, an additional supply of heat to ensure reasonable capacity. Moisture must be evaporated or converted to a gas before it can be taken up by the air. The air therefore should be preheated or some other source of heat provided so as to cause this evaporation as rapidly as possible. In designing a machine for drying at temperatures below 212°F. sometimes termed by air-absorption, one must take into consideration the capacity of the air for carrying off moisture and the amount of heat it can give up for evaporation. Air has a definite moisture-carrying capacity which increases through an accelerating curve as the temperature increases. Obviously it is advisable to have as high a temperature as conditions will permit in the air delivered to the dryer—but a careful examination must be made of the temperature at exhaust. Here are two factors: the moisture-carrying capacity at a given exhaust temperature—and operating economy. Operating economy is generally considered as being dependent on the difference between the initial and final temperatures. But it is desirable to have a high exhaust-temperature and operating economy calls for a low exhaust temperature, therefore a balance has to be determined which will give best results.

When there are no limitations such as temperature, discoloring of products, etc., the simplest form of dryer is a rotating cylinder provided with shelves or flights for lifting and spraying the material across the interior, through which the hot gases pass. Here direct evaporation takes place at 212°F. and the evaporated moisture is swept out by the flow of furnace gases, induced by fan or stack. The diameter and length of cylinder have to be proportioned so that the necessary volume of gases can be passed through at a velocity which will not cause excessive dust-loss and also allow time for transfer of heat. The character and size of material have also to be considered, as some require longer time than others, or it may be necessary to vary the distribution of falling material over the cross-section. This, in good design, is taken care of by the pitch and speed of rotation and by the shape of spraying flights. The heat may be introduced either at the discharge end, flowing in counter direction to the material, or at the same end as the material, flowing in the same direction. This type of dryer is not economical in operation. The temperature of dry material and exhaust gases are generally high. A considerable radiation loss is bound to exist and sometimes incomplete combustion results, causing smoke and further losses.

The simple direct-heat dryer has been improved in many respects with the primary idea of increasing efficiency. The first modification in design was probably the enclosure of the rotating cylinder in a brick housing. In this arrangement the gases pass first around the outside of the shell, transmitting their heat by conduction and later passing through the interior of the shell in direct contact with the material. This, while it shows greater economy and is less liable to affect the quality of the product, has objection in that the amount of brick work required for enclosing the cylinder is expensive. Furthermore, it requires considerable time to get the apparatus up to the drying temperature, due to the great amount of heat absorbed by the brick-work for which reason they should be operated 24 hours per day whenever possible. The brick enclosure, however, reduces radiation loss and promotes better combustion. The heat being applied to the exterior of the shell in many cases eliminates the tendency of materials to stick by forming a steam film when the wet material strikes against the hot plates and when properly used the objectionable features are offset by the advantages.

A further refinement of this principle comprises a rotating cylinder with a centrally located heat-flue attached to the cylinder and rotating with it. This dryer is undoubtedly one of the most advanced and economical machines for drying where conditions will permit its use. The principle of carrying the hot gases through a central flue avoids radiation losses and permits reducing the brick-work to practically just that required for the furnace. It is the ideal application of heat, bringing only dry gases in contact with the dry material and the moisture being withdrawn at the wet end permits low exhaust temperatures without danger of detrimental condensation. A recent improvement makes the centre flue rectangular, giving greater heating surface for the same area of section. The radiation from outer shell is negligible as the returning gases are at very low temperatures.

It is generally assumed that air must be used in drying in sufficient quantity to absorb the moisture. This is only true in certain types. In fact there is rarely sufficient air for this purpose in an efficient direct-fired dryer. Every pound of air or gases passing out of a dryer carries away heat, obviously the less air the less heat wasted under the same conditions of temperature. A large portion of the moisture may be carried off as steam partly condensed and some of the latent heat, in counter-flow machines, utilized in heating the fresh materials.

When it is desired to remove water of crystallization, break up chemical compounds, or for any reason to heat materials to high temperatures or burn out foreign materials, the temperatures required generally necessitate a refractory lining within the rotating cylinder; otherwise the arrangement is substantially the same as the single rotating cylinder. This is commonly referred to as a calciner, roaster, or kiln, and while not economical as compared to the advanced types of dryers referred to above they are generally superior to the stationary type of kilns and roasters.

Effective application of heat to material is a very important feature in drying, a quiescent mass on a tray or other surface is difficult to heat thoroughly so as to drive out the moisture. The material should be constantly turned over or sprayed through the hot gases so as to expose fresh surfaces to the heat. The spraying flights should be staggered so as to prevent channeling of the hot gases between falling rows of material; they are on occasion re-arranged and shaped in accordance with the character of the material as it progresses toward dryness, so as to get uniform distribution. No one type of dryer can be successfully employed for all products; consequently, expert engineering counsel must be obtained in selecting the proper equipment if efficient work is to be done.

The Dayton-Dowd Co., of Quincy, Illinois, announces the opening of a district office in Pittsburgh at 809 Keenan building, to handle the sale of its centrifugal pumps and underwriters' fire-pumps. The office will be in charge of T. J. Barry, who for the past several years has been connected with the home office on engineering and sales. Mr. Barry's experience fully qualifies him to give the pump users of his district exact data on their pumping problems.

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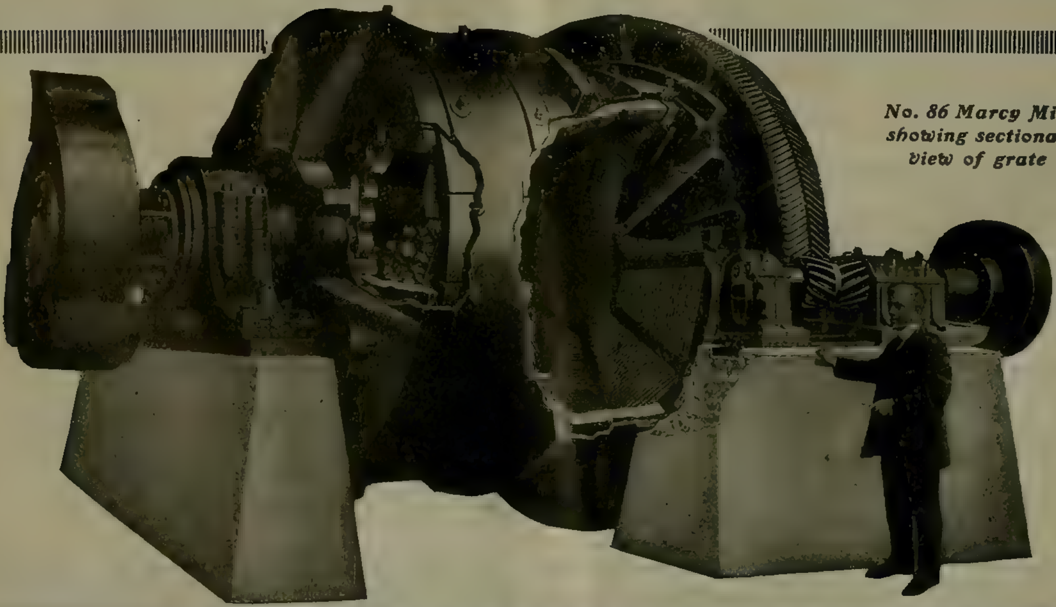

No. 86 Marcy Mill
showing sectional
view of grate

T. A. RICKARD, - - - - Editor

PRESIDENT HARDING'S appointment of Secretary Hoover as chairman of the Federal Commission to deal with the question of the development of the resources of the Colorado river is somewhat irregular, for it is a matter that, strictly speaking, should be placed in the hands of an official of the Department of the Interior, not of the Department of Commerce. The selection, however, meets general approval, for the duties involved will be performed best by one who is primarily an engineer, not a politician. Among the schemes proposed are the Lees Ferry project of the Southern California Edison Company, the Diamond Creek project of Mr. James B. Jirand, and the Boulder Canyon project of the U. S. Reclamation Service. The first would provide 600,000 horse-power, and the second, 125,000 horse-power. The Boulder Canyon scheme is primarily for the purpose of flood protection and irrigation, but, nevertheless, it would produce 600,000 horse-power.

ENORMOUS quantities of gold are being used in the United States by a number of industries and for personal adornment. For several years prior to the War the amount of new material absorbed in this manner and obtained from domestic and foreign coin and bullion averaged $35,000,000 per annum. During 1920 the value was $54,009,609, according to the report of the Director of the Mint. In addition to new metal, a certain amount of what is known as old material is re-melted at the mints and re-sold. This amounted to about $8,000,000 per annum before the War, but aggregated no less than $28,205,478 in 1920. According to a recent bulletin issued by the National City Bank, the grand total of governmental sales of the so-called new gold for industrial purposes since 1880 aggregates about a billion dollars. Most of this was used in the manufacture of articles for domestic consumption; the value of exports of gold ornaments is comparatively small, seldom reaching $1,000,000 per annum. It is probable that three-quarters of the gold used in this country for industrial purposes is utilized for the manufacture of jewelry; the dental trade absorbs an amount valued at about $4,000,000 per annum, of which, however, there is a considerable return for re-melting. It has been estimated that the consumption of gold-leaf is responsible for an expenditure of about $1,000,000 per annum. The enormous increase in the amount re-melted at the mints is indicative of a greater circulation of the metal in the arts and industries. It may be due also to the increased production of the cheap and shoddy jewelry that soon finds its way back to the melting-pot, and to changes in design dictated by fashion.

IS restriction or suspension of output justified at a time when a demand could be fostered by lowering prices to a point still within the limit of profitable operations? This question arose as a sequel to explanations made, at the recent meeting of the De Beers Consolidated Mines company, to explain the reason for the suspension of operations at the diamond mines in South Africa. The London 'Daily Mail' says that the government and the people of South Africa would be better off were prices reduced, a demand for diamonds fostered, and the mines re-opened. The proposal has the support of a section of the press in South Africa. In other quarters, however, it is maintained that the diamond syndicate, which controls prices and output, knows what is best for all concerned, and that the industry can be maintained during normal times only by an adherence to the policy that has brought wealth to the producers and the stockholders, and employment for others—the control of output to suit demand at a fixed price. Many owners of diamonds will sell if the syndicate reduces prices at the present time; for as soon as confidence is shaken in the value of the gem, it will part company from many who will prefer a more reliable investment. At times during the past year an entire cessation of sales by the syndicate has been noted. Conditions are improving slowly; and it may be that prosperity will soon re-visit the world's greatest luxury industry. If it does, the syndicate will claim justification for its present attitude.

SECRETARY MELLON has shown both intellectual honesty and courage in his statement concerning the payment of a bonus to all who served in the War. The bonus will cost $425,000,000 per annum for the first two years, if half the veterans choose the cash option, and the money can come only out of more taxes. There has been a popular delusion that the bonus could somehow be provided without touching the pocket nerves of the people of the United States, except perhaps those of a few of the rich; some financial legerdemain was to furnish the necessary funds for the purpose. Already $830,000,000 has been provided out of the national revenue for the benefit of those physically disabled in the War, and nobody begrudges that appropriation; but it is not realized that a further sum of $850,000,000 is demanded for distribution as a present to those who were not disabled and who performed a plain duty that few of them could have shirked had they wished to do so. The suggestion of using the repaid loans of foreign governments for the soldier bonus ignores the fact that those foreign loans are represented by the Liberty bonds, which must be retired as they become due. As Mr. Mellon says, the Government is morally obligated to the thousands of bondholders to do this; anything else would be dishonest. Unfortunately the whole question is being mixed with party politics; it is prejudiced by the oncoming Congressional elections. This is the time for courageous men to risk unpopularity by stating the facts, and to support the Administration, which is endeavoring, as the custodian of the national treasury, to do what is right.

PROFESSOR Gustav Cassel, a Swedish authority on economics, in a recent report of the Scandinavian Credit Company, discusses the disappearance of the gold standard. He states that only in the United States is there real gold currency today, and that other currencies must be studied and adjusted independently of the dollar. Frankly, we fail to see how such adjustment is possible. There must be some standard of value, and the American dollar is the only unit that has withstood the test of war and economic upheaval. Despite the Professor's prediction, the pound sterling is regaining its normal value automatically; when Anglo-American exchange is at par the pound may be considered again as a standard, but this will be possible only so long as its value remains in definite and fixed relation to the American dollar. The sovereignty of gold is not imperilled by the opinions of Professor Cassel. Although Great Britain is not on a strictly gold basis, the appreciating value of the pound sterling is an evidence of gold reserves, in the mines as well as in the banks. Currencies cannot be adjusted without comparison with something of tangible value. At the present time the only standard is the American dollar, which represents gold; other nations must recognize the fact that the value of their paper currency depends on the amount needed to buy an American dollar. The only feasible alternative to the gold standard is the issuance of flat money; and recent events in all countries but the United States have shown that this involves an economic fallacy that predicates financial chaos.

SPEAKING recently in New York, Mr. John E. Roversky, the vice-president of the National Bank of Commerce, made some pertinent remarks in regard to the dislocation that would ensue if the debts due to the United States from the Allies were collected at the present time. Such a happening, he maintained, would be disastrous to us, whether an attempt were made to pay in gold or in merchandise, for the immediate consequence would be a considerable fall in the rates of exchange. There is, moreover, insufficient gold in Europe for the purpose; dollar exchange would have to be purchased, and the rate would rise in proportion to the amount desired. This would accentuate the present unfavorable condition of foreign exchange. American goods would be barred from entry into foreign countries, being replaced by European products. If the collection of the debt were pressed, the consequence would be that foreign goods would force their way into our home markets and over any tariff wall that might be erected. Mr. Roversky remarks pertinently that the demanding of a tariff on imports contemporaneously with the collecting of debts would be an action similar to that of a creditor who insisted that the amount of his claim should be brought to his house, and then charged an admission fee at the door. The cancellation of the debt owed us by the Allies is recommended only by a small minority in this country. For the moment it is best to proceed cautiously, realizing the important facts in respect of the origin of the debt, and in anticipation of the inevitable result of an attempt to demand a large payment from Europe on this account at the present time.

WE know that there is gold in sea-water, but the fact has been exaggerated repeatedly until it has become a delusion and a snare. A story comes from southeastern California, where the waters of Mono lake are claimed to be gold-bearing sufficiently to make the lake a gold 'mine', or, as the newspaper reporter would say, the water contains gold "in commercial quantities". Indeed the Superior Court of Mono county sustained this economic contention in a suit brought by Mary Means Gale against W. Harrison Whitacre and others, in which the plaintiff claimed fraud. The Judge decided that the evidence introduced by the defendants was of such a nature as to convince him that the defendants were acting in good faith. He dismissed the suit and with it the claim for a return of the $2000 that Mrs. Gale had subscribed to the venture. It is stated that assays made by chemists in different parts of the country had proved that gold was present in amounts ranging from $3.60 to $200 per ton of water. We invite Mr. Whitacre to submit evidence to show the trustworthiness of his sampling. Assaying is much easier than sampling, and we venture to question the ability of the Court to understand the nature of the technical operations required to prove the average metallic content of a large body of water. It is said that Mr. Whitacre, who is a photographer, learned that the Indians used the lake water for medicinal purposes, that it served as a Keeley cure for alcoholism as well as for the tobacco habit. His experiments "proved that it was efficient in the development of pictures". Here, of course, we can place a finger on an error, for the proportion of gold, even at 10 ounces per ton of water, would not suffice for toning a photographic print. Mr. W. then had analyses made, so says the story, and thereupon perfected a process of electrolysis by which the water can be treated and its gold extracted at an enormous profit. Why then did he sell stock to the widow Gale—for, in order to give the sympathetic touch to the episode, we assume she is a widow. Mr. W. should have kept his secret, producd the gold, and then disposed of it to the German government for the settlement of the reparations owing to France; or, better still, he could have earned the undying gratitude of millions by giving it to the Secretary of the U. S. Treasury for distribution as a bonus to our ex-soldiers. A great opportunity has been lost, and, incidentally, an honorable Court has been hocus-pocused.

CALIFORNIA possesses much that is superlative, even after discounting all extravagant claims to distinction. It is now proposed to connect San Francisco with what are known as the Bay cities by means of a tunnel and a bridge that will eclipse all previous records for length. The cost is estimated at about $40,000,000, and the approval of the Federal authorities has been sought and obtained. San Francisco would benefit primarily by such an improvement, although it is maintained that the Bay cities will expand as a result of an increase in the number of homes that will be built there. Oakland, Berkeley, and the adjoining cities, however, see in the proposed bridge a diversion of trade to San Francisco; and so unanimity of approval is lacking. Whether there be justification for such a colossal outlay at the present time may be questioned, for the ferry services across the bay are adequate and comfortable; the boats and connecting trains are operated at reasonable rates, especially for commuters. The one defect in the trans-bay service is the inadequate provision for automobile transit. The proposed bridge would be used to such a large extent by automobilists that there is more than sufficient reason why the motor-car industry should be interested in the scheme. A boosting campaign was launched by an association of automobile dealers in San Francisco a few months ago, by which all and sundry were invited to view with enthusiasm every proposal for expansion; but the movement has succumbed, apparently, as a result of financial inanition and waning interest. Although we may be accused thereby of adopting the wet-blanket attitude, we are inclined to think that the time is not ripe for the inauguration of such an expensive undertaking as the building of the bridge across the Bay.

THE perennial debate as to whether the United States Assay Offices at New Orleans, Helena, Boise, Deadwood, Salt Lake City, and Carson City justify their existence is consuming some of the time of the Senate in deliberation over the Treasury Department Appropriations Bill. Senator Jones of Washington says that they are not needed; Senator Warren of Wyoming takes the opposite view. The original purpose of establishing these offices about 50 years ago was to afford a convenient place at which the miner of gold and silver could market his 'dust' or bullion, and receive prompt payment. That they no longer serve this purpose is proved conclusively by the fact that the purchases made by them are almost negligible; what little metal is consigned to these offices could easily be sent to San Francisco, Denver, or Philadelphia. The argument advanced by those who advocate retaining them is that the prospector should be accorded the privilege of having assays of his samples made at Government offices situated at convenient points. The purpose—to encourage prospecting—is commendable, but it is doubtful whether the number of prospectors who avail themselves of the opportunity is sufficient to warrant the maintenance of expensive establishments. We have not the figures at hand, but we venture the statement that the average cost to the Government of assays made at most of these offices is exorbitant. Moreover, the argument that the prospector benefits is not convincing, for the reason that reliable and competent custom assayers are to be found within reasonable distance of any district that is being prospected, and their charges are approximately equal to those fixed by the Government. In a recent bulletin from Washington, apropos of the subject, this statement is made: "The commitee had questioned whether an assayer and assistant assayer were needed, and had decided to abolish the assistant, but on investigation it was agreed that the assistant was necessary, due to inability of the assayer to perform all the duties". This may offer a clue to the reason for the advocacy of retention. If the "assayer" has not the ability to perform all the duties in one of these offices he is probably not an assayer but a politician; possibly he is also the nigger in the wood-pile. We are sceptical of the deep concern for the deserving prospector that is shown by our illustrious 'statesmen' at Washington.

OBITUARY notices of well-known processes or machines sometimes show a premature anticipation of their removal from active service. 'The Passing of the Gravitation Stamp' is the title of a communication in a recent issue of the 'South African Mining & Engineering Journal', in which a correspondent, after referring to the fact that "even Methuselah died", describes an alternative process of crushing as follows: "I heat the ore or mineral under treatment to a maximum temperature of 600°C. and then plunge it into cold water. The expansion caused by the heating and the contraction caused by the sudden cooling render the mineral extremely friable, in fact so much so, that two pieces of Rand banket from a depth of, say, 3000 feet, can, after being subjected to this treatment, be crushed in the hands as easily as two walnuts. This simple test can be made by anyone with the aid of the kitchen fire. This process does away with the gravitation stamp and makes the all-sliming of the ore and the consequent improvement in extraction a positive certainty". The idea may be classed as 'old stuff', as the 'inventor' admits; for he remarks, "The Transvaal Chamber of Mines clearly thought that the process described in the venerable publication of 1556 [Agricola's 'De Re Metallica'] bore a resemblance to the one for which I had applied for a patent. On the face of it no doubt they were right, but my patent agents are of opinion that my application of the process constitutes a distinct novelty". To which we would add that it probably does, and is. The scheme of royalties to be imposed by those who use the new process reminds us of the success attending the commercial efforts of the Minerals

Separation companies. "I propose," says the inventor, "to charge only a nominal royalty for the use of the process. In the case of mines treating a tonnage equal to the average Rand mine, I propose to charge a royalty of one half-penny per ton. This small amount of royalty would scarcely pay the cost of collecting in the case of small mines, and in such cases, as the extraction would also be increased by, say, 2 dwt., I propose to charge a royalty of three pence per ton. Every mine on the Rand that adopts this process will at once lessen its crushing costs to the extent of from two shillings to half-a-crown a ton, and they will at the same time increase their extraction to the extent of from one to two dwt." As the average residue on the Witwatersrand contains well under 0.5 dwt. per ton, we are sceptical as to the increased "extraction". Ore-sorting, crushing, milling, and tube-milling at a typical Rand mine costs about three shillings per ton; the saving claimed in the cost of crushing therefore is absurd. It has been known for centuries that crushing can be facilitated by heating the ore previously; but the new apostle of an ancient principle says nothing about the cost of raising the temperature of the ore to 600°C. The stamp-mill may be superseded eventually, but it will not be shaken from its foundations by such clap-trap.

UNDER 'Discussion', Mr. H. T. Darlington, a chemical engineer formerly on the staff of the Pennsylvania Salt Company, of Philadelphia, contributes an interesting note on a little-understood method of mineral separation. A number of years ago the company had accumulated at its Natrona plant in Pennsylvania a large quantity of slimed cryolite, the wastage from the treatment of the raw material obtained from Greenland. The crude product was used, under the name of 'kryolith', for the manufacture of soda, aluminum hydrate, and calcium fluoride, the last two by-products being at first discarded; later, the fluoride was found to be of value for use in open-hearth furnaces, and the hydrate was utilized to produce alum and aluminum. Later still, the Solvay process, using salt, displaced kryolith as an essential for the manufacture of soda, and at the present time the electrolytic cell is displacing the Solvay process in the manufacture of caustic soda. The Bayer process, on the other hand, using bauxite from France, is now used mainly in connection with the manufacture of enamels and opal-ware. The method of separation described by Mr. Darlington will provide additional food for thought to those interested in the theory of mineral separation by flotative methods. Mr. Charles Lintecum's note on the regeneration of cyanide from cupriferous solutions, by adding sodium sulphide and sulphuric acid and absorbing the hydrocyanic acid in alkaline water, is of interest, but the exceedingly poisonous nature of the gas is such that investigators have been discouraged from further research in this direction. Next the appreciation of gold in terms of British paper currency is discussed by Mr. S. J. Kidder, who defends the use of the term 'premium'. The recent rapid drop in the price of gold on the London market in sympathy with the rise in dollar exchange speaks for itself. Mr. E. P. Crawford gives some valuable notes on the treatment of concentrate in a locality remote from any smelter, referring to his own experience in Mexico. Mr. C. A. Grabill contributes a mild criticism of the fallacy that assumes it to be profitable to mine high-grade ore when metal prices are low and to mine low-grade ore when the market is in the ascendant. Our friend Professor Kemp is more than able to defend his view of the matter, but we suggest that conditions may arise when only high-grade ore can be exploited at a profit; in short, an economic aphorism says that "beggars cannot be choosers". We are glad to publish the complimentary letter from Mr. J. Parke Channing on Mr. Morton Webber's articles on the sampling of mines, together with a note taken from Mr. Channing's wide experience in this branch of technology. Mr. Kenneth B. McMahan corrects an error in a name appearing in an article re-printed by us from a bulletin of the U. S. Bureau of Mines. Mr. E. S. Smith draws attention advisedly to discrepancies between the price of articles made of brass and of iron. The exorbitant price levied on things made of brass is an obstacle to the consumption of copper.

COMPANIES that help their employees to acquire stock in their enterprises are acting wisely. The Southern Pacific Company has announced that any employee may make application for stock, which will be bought in the open market; the cost will be deducted, in small amounts if desired, from the monthly wage or salary earned. No request is made that employees take advantage of the offer; they are neither favored nor discriminated against because of action or inaction in this respect. The Southern Pacific Company has no stock in its treasury, all being in the hands of the public and distributed among about 54,000 holders. Details of the easy-payment plan are as follows: Any employee may apply for the purchase of from one to fifteen shares of stock, according to his ability to pay. After having completed any specified purchase he may begin to buy additional shares, but under no circumstances is he allowed, under the plan, to buy more than 15 shares at any one time, although he is not limited to the total number he may purchase in this manner. The expenses of the transaction will be borne by the company, the net cost of the stock being paid for by the employee at the rate of $5 per month per share; or the unpaid balance may be liquidated at any time. The company will charge the employee interest at the rate of 6% on the cost of the stock purchased, but will credit him with the full amount of dividends paid. In this connection it is interesting to note that dividends have been declared regularly since June 30, 1907, at the rate of $1.50 per share per quarter. At the present market-price of the stock—about $81.50—the rate ensures a return of slightly less than 7½% on the investment, which will more than counterbalance the charges made for interest on the unpaid portion of the shares purchased on the easy-payment plan. Failure to pay three successive installments will terminate the employee's right to complete the purchase; in such event the stock will be sold at the current market-price and the sum invested will be returned to the employee. If permanent disability or death ensues before acquisition of the stock, the employee or his estate may complete the purchase in monthly installments, by payment of a lump sum, or by means of other equally equitable arrangements. If an employee leave the service of the company he has the option of paying the outstanding balance in cash and receiving the stock; or he may receive shares equivalent to the money paid, and the remainder, if any, in cash. These details should be of interest to other companies that contemplate similar action. Profit-sharing is receiving increased attention; stockholding by employees is one of the best methods of participation, for the worker then becomes a capitalist, and views industry from a wider angle. He is interested if an increased profit can be made; he is concerned if operations are conducted at a loss.

ONE man's meat may be another man's poison, as the saying goes; there are two sides to every question. Users of gasoline and other products of crude-oil will rejoice to learn that conditions are such that an immediate rise in price is unlikely. From the refiner's standpoint, however, all is gloom. Listen to extracts from a tale of woe transmitted to Senator John W. Harreld, published in the January 19th issue of the 'Congressional Record', and written by the secretary of the Western Petroleum Refiners' Association, who says, inter alia, that ". . . the independent oil industry is in the most serious prostrate condition it has ever experienced. Never before in the history of oildom were there so many independent refineries shut down as at this time. Some are in the hands of receivers; some have simply gone out of business; practically every one of them is running far short of capacity. . . When importations of Mexican crude were suspended last summer there was immediate improvement in the oil industry in this country. . . Then a few men went down to Mexico City and made some secret arrangement with the Mexican Government. Mexican shipments to this country were resumed and almost immediately the independent oil industry in the United States was again plunged into depression. We have 75,000,000 barrels more of crude in storage now than we had last spring, when crude prices were so spectacularly cut. We have entered the winter with 79% more gasoline on hand than ever before in the history of the business. We have also entered the winter with 59% more fuel oil on hand than in any previous time. . . We are utterly unable to get any accurate statement of conditions in Mexico. For more than a year we were told again and again that Mexican oil wells had been 'shot to pieces' with salt water; that in a little while Mexico would be a thing of the past. We have been heralded for years with the threadbare statement we were facing a petroleum famine and yet the fact remains, as near as we can learn, that Mexico is producing more oil today than she has ever produced and that we have had greater production of American crude with more refined products than at any other time. . . Pipe lines are in operation from the Gulf of Mexico to Kansas City, Chicago and eastern tidewater. Now with cheap petroleum coming into these coastwise refineries by water, with oil moving to inner strategic points by pipe line, and with railroad rates so high as to be practically prohibitive, is it any wonder the petroleum industry in the United States is in a chaotic condition? Is it any wonder hundreds of oil men have been financially ruined with the inevitable effect of these agencies mentioned? Is it any wonder the independent oil industry is on its knees begging the Interstate Commerce Commission for a reduction in freight rates. . ?" After all, our oil supply is, comparatively speaking, so near to exhaustion that the existing advantages of cheaper fuel and cheaper lubricant, coupled with the ultimate advantages that will accrue from the conservation of domestic resources, by permitting unrestricted importation from Mexico, will more than counterbalance the distress experienced by the "hundreds of oil men" whose ruin, we are glad to learn, is merely financial.

The Oldest Copper Company

The fabrication of copper utensils and other articles by a mining company is not new. It was practised in Sweden in 1641 in connection with the operation of what at the present time is probably the oldest copper-mining company in the world, an interesting account of which appears in a recent issue of the 'Swedish-American Trade Journal'. From this we learn that the Great Copper Mountain Mining Company (Stora Kopparbergs Bergslags Aktiebolaget) was engaged in the mining and the smelting of copper ores almost 300 years before Columbus discovered America. The enterprise prospered, so that during the 17th century the company was by far the largest producer of copper. Records show that in 1655 the output was 3453 tons—sufficient for the needs of the world at that time. The original corporation appears to have been founded in 1225, and records indicate that a certain Bishop Peder acquired an eighth share in the mine in 1288. The Copper Mountain, as the mine was called, was at first the property of the parish in which Falun is situated; the extraction of the ore by the company was under State supervision—a method of control that was exercised until 1862. At times the royal regulations were severe, but the disadvantages were counterbalanced by subsidies. The stock of the company was divided originally into 'pars' or shares, some of which belonged to the Crown, the actual amount thus held fluctuating in such manner that the controlling interest was sometimes in the hands of private individuals, sometimes in the hands of the State. One document shows that, on occasions, the mine was operated by the private holders of stock for three days out of each four, the Crown taking charge during the remainder of the time. A 'par' was divided into four 'whole-fourths', each of which was subdivided into four 'fourth-parts'. In 1615 the stock of the company consisted of 75 'pars', 300 'whole-fourths', and 1200 'fourth-parts'. This quaint division of the holdings continued until 1888, when the present company was incorporated and when each 'fourth-part' was exchanged for eight shares of a total nominal value of 8000 kronor, the total capitalization being 9,600,000 kronor, or about $2,400,000. The ore was mined originally by individuals who thus exercised their rights as 'par' holders; it was smelted in picturesque little huts, some of which, it is learned, still survive as relics near Falun. Mining as a corporate enterprise began in 1716, although the private smelting of ore was not discontinued until 1862. The fabrication of copper utensils and other articles was the result of individual initiative until 1641, when a company monopoly was established. An operating plant was purchased at that date, and it remained in service for over 200 years. According to one estimate, during its long period of successful activity the Falun mine has produced 35,000,000 to 40,000,000 tons of ore and 1,200,000 tons of copper. During the latter part of the 19th century there were in Sweden many obstacles to the establishment of manufacturing and industrial operations. These were removed afterward, whereupon the Stora Kopparbergs company extended its activities, and is now engaged, on a large scale, in the manufacture of iron and steel, wood-pulp, and chemical products. Its success indicates that an apprenticeship in copper mining is an excellent preliminary to ambitious expansion in other directions; although, nowadays, centuries do not elapse before the ore-reserves of the average copper mine become exhausted.

Synthetic Gold

Synthesis is the making of a compound by the union of two or more elements; it is the opposite of analysis, which is the division of a compound into its constituent elements. To speak of 'synthetic' gold presupposes that it consists not of one 'element' but of several, the combination of which makes the metal that we all admire and value so highly. It is the value, of course, that excites popular imagination when a newspaper story asserts that somebody has found a way to make 'synthetic' gold. Such a story was given currency by two persons generally reputed to have good sense—Mr. Irving Fisher, a professor at Yale, and Mr. Roger W. Babson, a press writer on financial affairs. Mr. Babson went so far as to suggest that there was one way by which Germany might be in a position to pay her debts, and that was "to manufacture synthetic gold". He added, as if to give substance to his fancy: "Private advices have been coming to me for some time that German chemists are diligently working to discover some method for making synthetic gold . . . Reports indicate that a process has already been discovered for the making of gold from quicksilver, the only difficulty being that the present process costs more than the product is worth". That's the rub. One can make diamonds out of graphite, but the game is not worth the candle. It was done some years ago by a French chemist, whose operations excited the cupidity of Sir Julius Wernher sufficiently to cause him to put money into the venture, amid general laughter. The discovery of a process by which gold could be made would so demoralize our monetary system that we might be compelled to adopt the commodity dollar of Professor Fisher; and that may be the reason why he was in such a hurry to accept the German yarn. Later he made public acknowledgment that he had been misinformed, but this *démenti,* as the diplomats say, did not overtake the *canard,* which, like most of its species, had strong wings—the wings of imagination. Professor Fisher is reported to have visited the alleged inventor, who said that he submitted samples of his artificial gold to the Reichsbank in 1917 and "they had found it to be real gold". We quote from a statement made by Professor Fisher at Berlin on January 30. "But", adds the Professor, "a distinguished German scientist tells me that the man is a fraud and has a prison record." That sounds probable; so is the report that the Yale professor, since he made his first announcement about the German and his synthetic gold, has been inundated with proposals for becoming rich quickly; among them was an Italian invention for extracting gold from salt taken from sea-water on the Gold Coast of Africa. So this nine-day bubble has been pricked; but not before the U. S. Geological Survey issued a formal report stating that there was no occasion to fear the production of artificial gold. Moreover, it was denied officially that "the late S. F. Emmons claimed to have made synthetic gold from silver dollars many years ago". The denial would have been more effective, more scientific, and more just to the memory of a great geologist if it had been stated that it was Stephen H. Emmens who twenty-five years ago made claim to having transmuted silver into gold. He was exposed by Richard P. Rothwell in the columns of the 'Engineering and Mining Journal'. Samuel Franklin Emmons had no more to do with that fake than had William Jennings Bryan. The truth, as any chemist knows, is that some elements are being transformed continuously, and without human interference, into other elements. These substances are all radio-active, the energy made available during transmutation being about one million times more than could result from a similar weight of any other material. For example, it has been noted that uranium and thorium undergo a slow change of this character, with lead as the final product. So far no scientist has been able to delay or to accelerate this natural transformation. In time this may be accomplished, but at present it would appear that were it possible artificially to transmute lead into gold the energy required would involve a cost out of all proportion to the value of the precious metal produced. Should such a change be controllable eventually by human intervention, it is probable that the transmutation of gold into base metal would be more profitable as a commercial venture than would a change involving the opposite reaction, because of the immense amount of energy made available during the transmutation.

‘Boiling-Over’ Concentration

The Editor:

Sir—The Ancients made a blue-paint pigment by grinding lapis lazuli and by boiling it in goat’s milk, the pure lapis being skimmed. The German manufacturers of the higher grades of ceramic products practised boiling, and skimmed the impurities. Separations are thus possible with many substances not treatable by flotation; the principles involved and the actions taking place are widely different. ‘Boiling-over’ concentration has been used commercially in this country for the purification of cryolite from Greenland; non-metallic minerals may be separated from metallic under proper conditions, the non-metallic material coming to the surface and being removed; for instance, quartz may be removed from fluorspar by means of a soap solution.

The cryolite obtained from Greenland—the sodium-aluminum fluoride used so extensively in the manufacture of aluminum metal, white glass, and white enamels —is concentrated ordinarily by treatment by Wetherill magnetic-separators, which remove siderite, and by Wilfley tables, which remove galena, sphalerite, chalcopyrite, pyrite, and the residual siderite. The finished and pure cryolite is sold under the name of kryolith. Several thousand tons of accumulated slime from the Wilfley tables presented a difficult problem. If purified by subsequent treatment it had a value as high as $260 per ton. ‘Boiling-over’ concentration solved the problem, all impurities being removed, leaving a pure and white product, whereas the material charged to the plant was dark and valueless. By boiling in the presence of acid and without the use of addition agents, the coal, coke, pyrite, sphalerite, chalcopyrite, galena, and miscellaneous débris comes to the top and is removed. The siderite often dissolves before removal, as does the galena; this action depends on the acidity maintained.

The screened fine cryolite, passing 80-mesh, with about one part of water to two or three parts of cryolite, is delivered to a boiling-vat heated by a coil of extra-heavy lead piping. The vats are of cypress, 6 ft. in diameter by 7 ft. high. The unlined wood lasts several years; it is then lined with lead. Simple boiling brings to the surface a large quantity of organic dirt, which is skimmed. Then several buckets of acid are added and the tanks boil over. The foam, 2 to 3 ft. thick, is skimmed by means of 20-in. scoops of monel-metal fly-screen; it is then accumulated in settling-vats, smelted for lead, copper, and silver, or discarded. Boiling is repeated in a lower tank, to ensure a good extraction; the product is sent to a vacuum filter; after washing, it is dried in shelf-driers.

In starting a plant of the above character it is impossible to get foam for the first few days, unless kryolith ‘dope’ is used. This counteracts the oils present, particularly the linseed oil from paint and the anti-foam effect of new wood. An ounce of kryolith ‘dope’ produces a wonderful foam; it is made by boiling together eight parts of old oil from pipe-cutting machines (where old acid-pipes are threaded), one part of fels-naphtha, and one part of water. The oil used is presumably neatsfoot oil; new oil or other oils may be used, but generally are not satisfactory. A few drops of linseed-oil paint added to the contents of a large tank with a heavy foam will kill the foam; a little ‘dope’ will restore it.

Chrysocolla of the Inspiration type, and many minerals, particularly those that absorb water or that have rough surfaces, may be floated by boiling, provided kryolith ‘dope’ is added first. The oil particles of the ‘dope’ are precipitated within the pores of the mineral and form points of attachment for flotation compounds. Experimentally, flotation by boiling cannot well be demonstrated on the small scale; a tank 2½ ft. high and 3 ft. in diameter with at least 75 ft. of ¾-in. lead coil in the bottom, is the smallest that should be used. The steam should be controlled by inlet and outlet valves, to give high pressure in the coils. No coil should be placed in the centre of the tank.

Simple boiling is not usually sufficient. There is a critical point at which, by slightly increasing the speed of boiling, a hundredfold greater increase in foam results. Those who have made coffee or who have boiled ammoniacal solutions are familiar with this phenomenon, which is often termed ‘boiling over’. In the final evaporation of caustic soda in large cast-iron kettles it often occurs without warning, and is guarded against by providing a cup of oil just below the top of the kettle, which kills the foam when it is reached. But ‘boiling over’, is like many things we see daily—it is something that is inexplicable. We might say that some boiling flotation was accomplished by ‘boiling over’, as distinguished from simply boiling, and this phenomenon is influenced by the rate of boiling and also by addition agents used. In the larger plants, mechanical devices for removing the foam, methods for auxiliary agitation aeration, conservation of heat, and recovery of volatile matter have been provided. In an experimental plant the foams may be removed by screens or by steam-jet, but not by scoops or sieves or skimmers of the cream type, for these kill the foam too quickly.

When treating in the laboratory the same material that is handled in a large plant there is little indication of separation; by boiling in a 500-cc. beaker with the ordinary bunsen flame, nothing results; however, if several burners are arranged to heat the edge of the beaker, a foam $\frac{1}{32}$ in. thick will form at the centre, whereas commercial practice would give several feet of foam under similar conditions. The foam concentrate in the beaker may be removed by long strips of filter-paper, and after awhile a concentration is noticeable.

Oil-sands from Athabasca, in Canada, and from Colorado, Utah, and elsewhere remind one of loose sea-sand that is saturated with oil. The oil is easily separated by treating the material in boiling water and by providing for the condensation, with the steam, of the more volatile constituents. Success is ensured by rendering the hot mass slightly alkaline, then acid; a white sand results in a few minutes. Violent boiling brings about disintegration without agitation, but often is not as effective as the use of a more moderate heat with agitation. Oxidation often renders the sands suitable for separation without acid.

A 'boiling-over' plant to treat a few tons per day of fine material may be installed at a nominal cost, particularly where steam is handy; no other power is necessary. An experimental plant may be installed easily. A large plant may be operated cheaply if heat be conserved. The re-treatment of ordinary flotation concentrate is suggested; pyrite, sphalerite, galena, chalcopyrite, each behaves differently, and satisfactory separations have been accomplished. The removal of chalcopyrite from molybdenite, and of mica from graphite, have been accomplished on a small scale. Boiling and 'boiling over' are two different phenomena. The consternation of the cook or chemist when he suddenly realizes that 'boiling over' is occurring should result in the coinage of a new word for an old action that may find extended application in a new field.

Homer T. Darlington.

Natrona, Pennsylvania, January 2.

Cyanide Regeneration

The Editor:

Sir—Supplementary to the discussion brought out by Algernon Del Mar's article on the regeneration of cyanide during precipitation by zinc, it would be of interest to hear from any of your readers who have tried regenerating the cyanide from cupriferous solutions.

A few years ago the subject of acid regeneration received favorable comment in our columns; and, inasmuch as it appears so promising, some of your readers may have tried it on a working scale. I have tried it in a laboratory, the following results being typical: Fresh solution containing 22.1 lb. per ton free cyanide (KCN) was reduced to $\frac{1}{2}$ lb. per ton by the addition of a copper salt; excess sodium sulphide and sulphuric acid were then added, and the hydrocyanic acid evolved was passed through alkaline water. After five hours a 50% recovery resulted; at 24 hours, over 70%. The idea of drawing off and collecting the hydrocyanic acid has the advantage that the solution so treated may be run to waste and replaced by fresh, where water is not scarce.

Chas. Lintecum.

Tonopah, Nevada, January 23.

The So-Called Premium on Gold

The Editor:

Sir—In reply to the criticism of Mr. von Bernewitz in your issue of January 14, respecting England's payment of a premium to South African gold-producers, it was not my intention to describe the method of payment, how the amount of the premium was arrived at, or how long it would last, but to bring out the fact that England recognized the situation which confronted the gold-producer and took such action (July 24, 1919) as would enable South African gold-producers to *"realize a premium* over the normal local currency value of their gold".[1]

The following citations would seem to indicate that the premium was a real one.

H. N. Lawrie, Chief of the Precious Metals Division of the American Mining Congress, in referring to the decline in gold production in the United States and South Africa in the five-year period following 1915, gives statistics on production and then says:[2]

"The rate of decrease was therefore four times as great in the United States as in South Africa. This resulted . . . partly from the fact that the American producer could not benefit by the *exchange premium,* the United States dollar retaining its par position with respect to all other currencies."

Again, H. F. Marriott, consulting mining engineer, speaking at Leeds, England, in referring to South African production in 1920, says:[3]

"The additional revenue due to the increased price (of gold) obtained from January to October 1920 is estimated at £8,315,196, 28.9% of the standard total. Another aspect of the *gold premium* is its effect on ore-reserves, as it enables many of the shorter-lived mines to include within the profit-limits many blocks of reef standing in the mines, which had previously been classed as unpayable."

Again, W. A. Doman, London correspondent, in referring to the gold mines in India, says:[4]

"The companies were severely handicapped by the method of selling, for the *premium,* which was available to the mines of the Rand, did not operate to the advantage of those of India."

Again, Mr. Arthur Moline, general manager for the Bendigo Amalgamated Gold Fields, Australia, says:[5]

"The saving feature of the situation was the *premium* obtained by the sale of gold abroad, chiefly in the Far

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[1] E. & M. J., October 16, 1920, p. 771.

[2] Ibid, January 22, 1921, p. 141.

[3] Ibid, January 22, 1921, p. 190.

[4] Ibid, January 22, 1921, p. 194.

[5] Ibid, January 22, 1921, p. 192.

East and also in the United States. This *premium* is approaching a total of £2,000,000, which has been of material help in the industry."

Alexander Gray, in comparing the relative standing of the Hollinger mine and the New Modderfontein, says:[6]

"The bonus obtained by New Modderfontein over the standard price for gold in the year ended June 30th, was 44.2%, whereas the Hollinger *premium* in this calendar year was about a quarter of that figure."

S. J. Kidder.

Mogollon, New Mexico, January 21.

[The fact that a number of persons use a term erroneously may excuse others for imitating them, but it does not alter the fact that the so-called premium merely measures the discount on the British paper pound, as expressed either in gold or in American dollars.—Editor.]

Treatment of Concentrate

The Editor:

Sir—The article by A. B. Parsons in your issue of January 7, in which the economic problems of the metallurgy of the California Rand ore are so interestingly discussed brings forcibly to my mind a problem that is becoming increasingly common and more pressing for mine-operators in western Mexico. It is the disposal of the concentrate produced at mines remote from smelters, for the very high charges for transport and treatment render it increasingly difficult to make a reasonable profit from ores that yield a medium-grade concentrate. It is going to be even more necessary in the future than it has been in the past to market a high-grade product, whether in the form of bullion, precipitate, or matte.

As a typical instance, I will give the conditions prevailing at a small mine in western Durango with which I am connected. It is situated about 65 miles from the railway. The ore gives over 90% recovery of precious metals by flotation, but owing to the large amount of sulphide minerals contained and the consequent low ratio of concentration, the grade of the concentrate is only 150 oz. silver and 1 oz. gold. It costs $50 or more to ship and treat at the smelter. The daily output of concentrate will be from two to five tons, depending on the character of ore and the tonnage milled, and it is desirable to recover only the precious metals, as the lead content is small and copper is absent.

A satisfactory method of treating the concentrate should combine a small cost of plant with a good recovery of the precious metals. The actual cost of treatment may vary within rather wide limits without seriously affecting the economy of the operation. There are two methods that appear promising: first, smelting in a small reverberatory furnace to produce high-grade matte for shipment (using wood as fuel); second, a chloride roast with subsequent extraction of silver and gold by hyposulphite of soda and precipitation with calcium sulphide. The latter method has the decided disadvantage of giving a poor extraction of gold.

It will be interesting to know what progress has been made in solving similar problems elsewhere and whether there is any immediate prospect of applying a new process, such as chloride volatilization to the successful solution of the problem.

E. P. Crawford.

Silver City, New Mexico, January 28.

Appraisal of Ore-Reserves

The Editor:

Sir—With reference to the recent purchase of the American Brass Co. by the Anaconda Copper Co. there appeared on page 98 of your issue of January 21 mention of the report of James F. Kemp on the Anaconda property, in which appeared the following statements:

"The ore is said to be of all grades from a general minimum of about 3% to a percentage of 10 to 15."

"The ore is carefully taken so as to use lower grades in times of high copper-prices and higher grades in times of low prices. In this way the available supply is and has been carefully conserved."

I am surprised to see this common fallacy appear unqualified, and apparently with Mr. Kemp's complete endorsement. Probably the original report contained some explanation that would warrant the practice of the Anaconda company, but belief that the way to handle a mine is to mine high-grade ore in times of low prices and low-grade ore in times of high prices is so common that many who ought to know better will take the above statement as endorsement of their general practice. The principle involved seems so unjust to the owners that I should like to see some one attempt to justify it, at least on grounds other than the effect on the stock market.

As a general condition the principle is absolutely incorrect; the reverse is true. Without going into complicated algebraic formula, take an extreme case: Assume a mine completely developed and having reserves of 100,000 tons of 5% copper and 100,000 tons of 10% copper ore. Assume also that the cost of putting the copper on the market is $12.50 per ton and that the capacity of the plant is 100,000 tons per annum. To make the case extreme and for the sake of round figures, assume that the price of copper this year will be 12½c. per pound and next year 25c. per pound.

Following the principle enunciated by Mr. Kemp the 100,000 tons of 10% should be treated this year and would net $1,250,000. The low-grade ore treated next year would net the same and the stockholders or owners would, or should, have the benefit of the interest on the first year's profits, say, $70,000, making a total of $2,570,000, leaving the mine worked out.

To reverse the principle and treat the low-grade ore in time of low price would result in no profit this year, but a profit of $3,750,000 next year, or a gain for the owners of more than a million dollars; and I maintain that this is the correct principle to follow.

If it be objected that in times of high prices high costs interfere with the correctness of the above calculation then assume the cost not in dollars per ton but in pounds of copper per ton. This would be true in general because costs must follow the commodity index: Assuming the cost of putting the copper on the market at 100 lb. or 5%, the low-grade ore would yield no profit whether treated in time of high price or in time of low price. The high-grade ore, however, would net twice as much to the owner if treated in time of high price.

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[6] Ibid, December 31, 1921, p. 1049.

It is true the output of the mine would run from one extreme to the other, but not more so than has Anaconda's in recent years.

The general principle may be stated thus: the greatest financial gain to the owner of a mining property is obtained by mining the highest-grade ore available in times of high prices. This is true even if the mine has to be run at a loss at a time when the financial world is in *borrasca*.

Los Angeles, January 30. C. A. Grabill.

Sampling of Mines

The Editor:

Sir—It perhaps is not too late to commend the excellent article by Mr. Morton Webber on 'Errors Latent in Mine-Sampling', published in your issue of November 5, 1921. Everyone who samples mines should carry it along with him, in addition to Mr. Webber's article on the 'Combination Method of Mine-Sampling', which appeared in your issue of February 28, 1920.

A number of years ago I was sampling a gold mine in North Carolina, and a negro miner who was helping me called my attention to the fact that the values in a vein were contained in cross-veins of chalcedony which probably were not over an inch wide. These cross-veins occurred only occasionally and were very rich, so that if enough of them happened to be cut in the samples all the results were vitiated.

Mr. Webber's suggestion about washing down the openings in a mine deserves serious consideration. Over twenty years ago I examined a copper mine in Nova Scotia in which the veins varied from 4 ft. to 8 ft. wide. The ground was hard and tight, without any well-defined walls, and when I started to sample I found that the slime covering the roof of the drifts entirely obscured the ore. Labor was efficient and relatively cheap, and so I had a supply of birch brooms made and set a couple of dozen miners washing off the tops of the drifts. This was accomplished in a relatively short time and I was then able to sample intelligently. It is interesting to recall that this mine was presented to certain interests in New York, with the report of an eminent metallurgist based upon the assumption that the ore carried 4% copper. My samples of the ore in place averaged about 2%. I found that the man who had examined and reported on the mine had assumed that the large pile of ore at the shaft was representative of what had been taken out. The fact of the matter was that it had been carefully sorted and the reject had been thrown over the edge of a gulch near-by and so was not in evidence. His excellent and elaborate metallurgical calculations, based upon the sample of the stock-pile, were unjustifiable, of course, and I was under the necessity of reporting unfavorably upon the property. A mining engineer would hardly have made the mistake of this eminent metallurgist.

New York, January 26. J. Parke Channing.

A Correction

The Editor:

Sir—In your article on 'Tungsten in Colorado', in the January 28 issue, you refer to W. H. Wanamaker, Mr. Conger's partner. This should have been Nels D. Wanamaker.

Mr. Wanamaker is now living at No. 608 Fourteenth street, San Diego. He is now 83 years old and still prospecting. He has just recently located several claims in south-western Arizona that carry very high values in free-milling gold ore.

Mr. Wanamaker and Mr. Conger, each thinking the other dead, just within the last few days got into communication with one another, through an article in the Denver 'Post'.

Mr. Conger, although 89 years old, is still prospecting in Colorado.

I am sending you this information thinking that you no doubt want credit placed where credit is due and for the further reason that some of your readers at least are interested in the comparatively few old-time prospectors that are left.

Kenneth B. McMahan.

La Mesa, California, February 4.

Iron and Copper

The Editor:

Sir—While the subject of the great discrepancy in the retail prices of manufactured articles of iron and copper is receiving some well-merited discussion, permit me to call your attention to an instance that would seem to merit the attention of producers.

Enclosed are two sheets from the catalogues of large Pacific Coast hardware-houses, quoting prices on 'Bright and Brass Wire Screw Eyes'. The prices in each catalogue are practically the same. Take, for example, screw-eyes, size No. 104. A gross weighs about 5¼ pounds. The price per gross for the iron article is $7; for the brass article $30. If the cost of manufacture of the brass article is not materially more than that of the iron one, it will be apparent that the consumer is asked to pay over $4 per pound for brass.

Looked at in the same way, the price of brass in the smaller size screw-eyes is over $5 per pound.

Swansea, Arizona, January 27. E. S. Smith.

The Government helium plant at Fort Worth, Texas, is producing over 290,000 cu. ft. of the gas per month, at a cost of 20c. per cubic foot. After the helium has been extracted the natural gas is transported in pipelines and consumed throughout northern Texas.

Structural Steel Practice in United States and Europe

By P. B. McDonald

Recently there has been a good deal of controversy about, and comparison of, British and American practices in structural-steel design. R. Fleming, of the American Bridge Co., in the 'Engineering News-Record' (September 16, 1920), led off with a review of a British book on the subject. Mr. Fleming pointed out that British engineers have not attacked the problem with a proper sense of proportion and have not specialized in the field as have American engineers. More specifically, he stated, British writers on structural-steel work prefer tedious algebraic methods where graphic methods are simpler and more quickly performed; they cling to antiquated and obsolescent designs, apparently from perversity; they record no failures in steel structures, although there certainly are occasional failures by British designers as by others; they bend angles remorselessly, in ways that would not be tolerated in American shops, etc.

In a later issue of the 'Engineering News-Record' (November 18, 1920), P. L. Pratley, a distinguished Canadian engineer, undertook to answer Mr. Fleming. He explained that British practice in structural steel depends more upon experience than upon books; that seldom do British engineers 'figure' a bridge or compile a stress-sheet; for example, no stress-sheet can be found for the famous Forth bridge; in fact, Mr. Pratley is disposed to believe that the profound American faith in 'figures' and 'figurability' tends to narrow and hamper structural-steel work in the United States. In British circles, he continued, there is a disposition to treat a steel structure as a unit, not as a conglomeration of units; the members are regarded as working together, mutually helping, rather than each unloading its responsibility on the next member. For example, he remarked, the short stringers, shallow-floor beams, and wide-truss members of a British bridge are conceived in a spirit of participation; whereas American practice forbids a stringer to help the bottom-chords, or a truss-vertical to help the floor-beams. As for the bending of angles, he stated, it is done in Europe because there is an ample supply of capable angle-smiths; and angles are efficient connecters and stiffeners. In general, Mr. Pratley concluded, American practice has been influenced by the German thirst for unnecessary detail; of late years, however, it has been drawing nearer to British practice, as in the abandoning of pin-bridges in favor of riveted joints, and the use of continuous spans and even of continuous transverse frames composed of floor-beams and truss-verticals.

Edward Godfrey of Pittsburgh, an American engineer, replied sarcastically ('Engineering News-Record', December 16, 1920) to Mr. Pratley's complacent explanations. He condemned the British custom of building by 'experience' and then nursing the structure for its lifetime by inspection and repairs. He condemned bent angles also, as well as other details of British practice.

In the same issue H. R. White, an Englishman employed by the U. S. Steel Products Co. in London, contributed an excellent letter favoring, on the whole, American practice. He said: "There are same fearful examples of structural atrocities in Great Britain, and one does not need to go outside London to find many of them . . . The only conclusion is that these freak structures never carried anything like the load the designer thought he was providing for. Such structures give the impression that they might be strengthened simultaneously with a considerable reduction in weight and saving in cost. In showing an American visitor these structures, one must be apologetic. The bridge carrying the Northeastern Railway over the Wear at Sunderland is a curious design. It is a through-truss span with parabolic top chord, evidently figured on the basis that such a span has no web-stresses, for it has no diagonals. The partly loaded span does not appear to have been considered but as the result apparently did not 'look right' the spaces between the verticals were completely filled in by huge plate-gussets with one large oval hole in the centre proportional to the size of the panel. A student of secondary stresses due to deformation under partial loading could have no finer example than this".

Mr. White very properly traced back these national differences in design to the educational systems characteristic of the two countries. He said: "The young British structural engineer just out of college is not capable of designing anything but the simplest structures, and has all his details to learn so far as commercial work is concerned. The American is better equipped in this respect, but on the other hand the Briton seems to have a much better general knowledge of engineering, and will know something of electrical and mechanical work, foundry, smithing, and machine-shop practice. In the United States, highly specialized structural engineers with an appalling ignorance on general subjects are frequently met—men who do not know the difference between direct current and alternating current, and who have little conception of mechanical work. They also seem to know less of general conditions which affect the sale of the work they handle, particularly in countries outside the United States".

Additional interesting comparisons of American and European design of bridges can be found in 'Engineering and Contracting' of October 26 and December 28, 1921. Dr. P. H. Chen, a Chinese engineer, pointed out in the issue of October 26 that European bridges look weak and apparently lack rigidity, whereas American bridges for similar spans and loads are almost too heavily braced and stiffened. Dr. J. A. L. Waddell, a widely known American engineer, and author of 'De Pontibus', answered him, and discussed the choice of soft or of high-carbon steel for bridges. In the issue of December 28 Edward Godfrey (mentioned previously) suggested that American locomotives and trains are heavier than those of Europe, hence the need for heavier bridges; and he added, "It is astounding the things that are proposed and executed in steel; it is still more astounding the things that stand up and carry loads". If anyone wishes to read more thoroughly into the comparison of American and European structural-steel work, this same Mr. Godfrey had a longer article on the subject in the 'Engineering Record' of March 1, 1913.

The whole subject has been recalled to my mind by receiving for review a handsome leather-bound copy of Milo S. Ketchum's 'The Design of Steel Mill Buildings', being the fourth edition, re-written since the first appearance of the book in 1903. When I was an undergraduate at college, Ketchum's 'Steel Mill Buildings' was a familiar book to the students. Something like 16,000 copies have been issued altogether. Professor Ketchum's book is typical of specialized American practice in structural engineering—typical of the 'figurability' that the Canadian engineer found characteristic of Americans, typical of our liking for graphic solutions, and of our custom of recording scientific processes in a book.

The thorough method in which Professor Ketchum has handled the subject is evident from a plan of the book. There are three parts and an appendix. Part I covers the calculation of the stresses in simple beams, trusses, portals, the transverse bent, and the three-hinged arch. It is a sort of preliminary course in stresses in framed structures. Part II covers the calculations of the deflection of structures, the calculation of the stresses in statically indeterminate girders, trusses, and frames, and secondary stresses in trusses. This discusion of statically indeterminate structures covers most problems in building contruction and is preliminary to a study of movable, arch, cantilever, and suspension bridges. Part III covers the design and construction of steel-frame buildings for mines, smelters, and other industrial plants. Among the detailed designs given are those for a crane-girder, a roof-truss, and a steel building. The appendix gives a complete specification for steel-frame mill-buildings. The book as a whole is a companion volume to the author's 'Structural Engineers' Handbook', which is equally well known.

As Mr. White pointed out, such excellent textbooks on structural steel as this one of Professor Ketchum are relatively rare in England. He explained that the British texts usually fall into one of two extremes: either they are academic treatises on the higher mathematics of the subject, suitable mainly for mental discipline, or they are too 'practical' handbooks that omit really essential theory. Our inventive and pragmatic American genius is at its best in such a field as compiling a textbook on steel mill-buildings. On the other hand, as Mr. White likewise pointed out, many of our young engineering graduates that know all about structural steel know very little about anything else. Not only, as he hinted, do they know nothing about alternating current and direct current, but they know nothing about the currents of thought that interest educated men—about the history of civilization and the meaning of culture and the place of man in the universe of which he is a part.

Perhaps American engineering students have fallen too much into the habit of thinking that specialized technical books like 'Steel Mill Buildings', well written and important though they are, represent all that is worth studying at college, since such trivialities as English, literature, history, and philosophy cannot apparently help them immediately upon their graduation. Moreover, they observe that the engineering deans show great deference to a professor who teaches a highly specialized technical subject, while barely tolerating as a necessary evil any teacher of literature who may have edged his way into the faculty.

For many years materials such as sand, gravel, and crushed rock have been handled by centrifugal pumps and pipe-lines, states the 'Mechanical World'. This success prompted many to turn their attention to the problem of pumping coal from the coalfields to tidewater by similar means. Lately this problem has received considerable attention from engineers and the owners of public utilities. In a paper on the subject delivered before a meeting of the Edison Illuminating Society, the data given would seem to prove that the cost per ton is much under present coal rates. There are, on the other hand, problems of engineering and operation that make the solution by no means simple. The question of erosion of the pipe-line, as well as lowering of the grades of coal resulting from rubbing and breaking, is still unanswered. The paper did not give the amount of water required per ton of coal, but in view of the experience in handling gravel, the ratio of water to coal will undoubtedly exceed three to one, which involves a large water supply, which, to avoid serious corrosion of the pipe-line, should be comparatively free from acid.

Tin ores become conductors of electricity at moderate temperatures, according to an article in 'Metall und Erz'. By using large pieces of ore as a resistance, sufficient heat can be developed to melt it and reduce it to metal on the addition of coal. It is not generally necessary to add any slagging material, nor is it necessary to protect the tin oxide from going into the slag. It is preferable to carry out the process in a trough-furnace with a low charging-shaft and two or more electrodes dipping into the bath. Ore and coal are charged and the metal is tapped from the bottom until the hearth is nearly full of slag, which should be rich in tin. This is cleaned by adding a charge of coal only to separate its tin contents as metal. Pure metal may be obtained, and the tin content of the slag reduced to 0.3%. The losses by volatilization are much less than by other processes.

The Function of Oil in Flotation

By Dana W. Leeke and Ralph H. Jarvis

The following metals have been arranged in series according to the intensity of their potentials or solution-tensions. In order of decreasing potentials they are sodium, calcium, magnesium, aluminum, zinc, cadmium, iron, nickel, tin, lead, bismuth, antimony, arsenic, copper, mercury, silver, platinum, and gold. This series is known by either of two names, the potential or electromotive series. The following metals were selected to demonstrate the condensation of gases and air in the form of bubbles by metallic surfaces immersed in liquids: sodium, magnesium, aluminum, zinc, iron, nickel, lead, copper, silver, and gold. Due to similarities in properties, these selected members of the potential or electromotive series were subdivided into three groups: Group 1, sodium and magnesium; Group 2, aluminum, zinc, iron, nickel, tin, copper, silver, and gold; Group 3, lead.

Sodium and magnesium were placed in Group 1, because they both react chemically with water, with the liberation of hydrogen. The chemical reaction between sodium and water is violent. Sodium particles that have been thoroughly coated with coal-tar or pine-tar by immersion, possess for a few seconds (seldom over ten seconds) the physical property known as flotability, when placed on the surface of water. The heat of chemical union, resulting from the reaction between sodium and water, soon lowers the viscosity of the pine-tar and coal-tar. Oils with less viscosity than pine-tar and coal-tar, such as wood-creosote, castor-oil, and pine-oil, when used with sodium, do not produce as marked an effect in retarding the chemical reaction between sodium and water. The particles of sodium, after chemical action has started, revolve rapidly on the surface of the water. To illustrate the condensation of hydrogen gas on a sodium particle, one may immerse the particle in water; numerous bubbles of hydrogen gas can then be seen that adhere to or detach themselves from the sodium particle. The remainder of the metals chosen from the potential series by the experimenters were prepared as thin sheets.

	Symbol	Dimension cm.	Weight
Magnesium	Mg	1 x 1	5
Aluminum	Al	1 x 1	10
Zinc	Zn	1 x 1	10
Iron	Fe	1 x 1	30
Nickel	Ni	1 x 1	50
Tin	Sn	1 x 1	30
Lead	Pb	1 x 1	20
Copper	Cu	1 x 1	35
Silver	Ag	1 x 1	30
Gold	Au	1 x 1	20

The third dimension can readily be estimated from a table of specific gravities. It is not necessary to prepare these metals as thin sheets, but those who care to undertake these experiments on metallic surfaces will be rewarded adequately for the time and trouble involved in preparing them in this way.

Magnesium. On submerging a particle of magnesium in distilled water, minute bubbles of hydrogen gas condense immediately on its surface. A particle is a subdivision of matter that is visible to the eye. When sufficient hydrogen bubbles have attached themselves to the magnesium particle, the particle is raised to the air-water interface. The magnesium particle will not rise to the air-water interface if this experiment is repeated in a 0.2% or a 0.1% solution of potassium permanganate. In all probability the hydrogen gas as liberated unites with oxygen, the permanganate furnishing the oxygen. Magnesium particles that have been insulated with a film of coal-tar or pine-tar do not condense hydrogen bubbles on their surfaces when immersed in distilled water at 20°C. Bubbles produced mechanically in the solution adhere to the oil-filmed magnesium particles, and buoy these to the surface. Chemical action between water and magnesium is practically nil in this experiment.

Without oiling their surfaces, particles of aluminum, zinc, iron, nickel, tin, copper, silver, and gold, if immersed in distilled water at 20°C., can be floated by bubbles produced mechanically in the solution. By oiling their surfaces, particles of aluminum, zinc, iron, nickel, tin, copper, silver, and gold, if immersed in distilled water at 20°C., can be floated by bubbles produced mechanically in the solution. With and without the use of oil, bubbles were condensed on the above particles, proving that under certain conditions oil is not necessary to the condensation of gases on metallic surfaces.

Lead was grouped separately because of the fact that it oxidizes rapidly in air at normal temperatures. A brilliant metallic lustre may be produced on lead at normal temperatures, provided the film of oxides is removed while the lead particles are submerged in distilled water or oil. Lead particles can then be floated readily, thus proving that oil is necessary in case the chemical changes taking place at the metallic surface produce a pronounced lowering of the potential. Zinc, which oxidizes in air at normal temperatures, although not as rapidly as lead, could be grouped with lead. It is not inferred that the other metals do not oxidize in air at normal temperatures; but this oxidation is particularly pronounced on lead.

Perhaps some of the most illustrative experiments performed were those in which bubbles 3 mm. in diameter were condensed on the following metallic surfaces: aluminum, nickel, tin, copper, silver, and gold. This was done by means of a laboratory dropper with rubber bulb attached. These experiments can be accomplished on oiled or unoiled metallic surfaces in distilled water.

The following members of the potential series, magnesium, aluminum, zinc, iron, nickel, and tin, were immersed in a concentrated solution of copper sulphate at 10° or 20°C. All the metals precipitated copper on their surfaces. The same experiments were repeated under the same conditions, except that the surfaces of the metals were filmed with wood-creosote. The precipitation of copper on the metallic surfaces was retarded and less marked. The experiments were again repeated under the same conditions, except that the surfaces of the metals were filmed with pine-tar and coal-tar. No precipitation of copper took place. After two hours submergence in a saturated solution of copper sulphate the metals still possessed their metallic lustres, when filmed with pine-tar and coal-tar. These experiments prove that in ionic chemical reaction is retarded between an electrolyte and an oil-filmed metallic surface. Other similar experiments were performed with silver and lead salts, which verified the above conclusion.

Sulphides. Estimations of Potentials. Four distinct methods were devised to estimate the lowering or raising of the potential of sulphide particles when agitated with various electrolytes. Of the four methods, the following was found preferable: produce mechanically at the orifice of a glass tube an air-bubble; the intensity of the potential of a sulphide particle or particles can be estimated by the degree of attraction between the sulphide particle or particles and the air-bubble; a small glass syringe can be used to advantage in producing bubbles of uniform size; a laboratory dropper with rubber bulb attached may be used in case of emergency to produce bubbles mechanically. The angle of contact between a bubble and a sulphide particle has a rôle so important in these tests that all bubbles produced must conform to a set standard. The standard established and used throughout these experiments was such that the bubble produced on an orifice of 2-mm. diameter, at a depth of 2 cm. in the electrolyte, had a maximum diameter of 5 mm. These bubbles are not perfect spheres.

After a careful study of many screen analyses, minus 50 plus 60 mesh was the particle-size chosen to test the effects of various electrolytes on the potentials of the sulphides. All particles smaller than 60-mesh were rejected. Sulphides used were as follows: chalcopyrite, galena, molybdenite, pyrite, sphalerite, and stibnite. Procedure was as follows: weigh quickly two 25-mg. portions of freshly prepared sulphide particles; add one portion to distilled water, and the other portion to the electrolyte whose influence on the potential of the sulphide you desire to ascertain. Agitate the two violently for one minute; then compare the difference in potential between the two portions agitated, by the readiness with which each adheres to a bubble, of 5 mm. diameter at a depth of 2 cm. Or, instructions for a test in detail would be as follows: Weigh out two 25-mg. charges of minus 50 plus 60 mesh pyrite particles. Add one portion to distilled water and the other portion to 0.1% solution of potassium permanganate, the temperature of the two solutions being 20°C.; then agitate for one minute. The pyrite particles agitated with distilled water will adhere readily to a bubble 5 mm. in diameter. The sulphide particles agitated with a 0.1% solution of potassium permanganate will not adhere to a bubble 5 mm. in diameter. When the intensity of the potentials has been compared on the two portions, wash thoroughly, by decantation, the portion agitated with the solution. Then ascertain if there has been a change in the metallic lustre.

Pyrite is the only sulphide of the group that indicates, by pronounced change in lustre, the effects of an oxidizer or reducer, an oxidizer being a salt or gas in solution that lowers the potential; a reducer, a salt or gas in solution that raises the potential. Particles of pyrite, when agitated for one minute with a 0.00625% solution of potassium permanganate at 20°C., indicate a change in metallic lustre.

Molybdenite was excluded from the following tests, because its potential remains constant, as compared with the behavior of the other five sulphides.

Agitation Tests. Chalcopyrite, galena, pyrite, sphalerite, and stibnite were agitated for one minute, with sulphuretted-hydrogen water, 0.1% and 0.2% sulphur-dioxide water, and 0.05%, 0.1%, and 0.2% solution of potassium permanganate at 10° or 20°C. Having no data on the use of sulphuretted-hydrogen water, the following strength of solution was applied: One cubic centimetre of saturated sulphuretted-hydrogen water was added to 20 cc. of distilled water. The potentials of the sulphides, when agitated in sulphuretted-hydrogen or sulphur-dioxide water were equal to or greater than the potentials of the same sulphides when agitated in distilled water. The potentials of the above sulphides approached zero when agitated with the solution of potassium permanganate.

Agitate particles of the five sulphides in a solution of 0.2% potassium permanganate to which 0.1% of wood-creosote has been added, for one minute at 20°C. The potentials of the sulphides do not approach zero. Repeat these experiments, substituting pine-oil and pine-tar for wood-creosote. The potentials of the sulphides do not approach zero. The experiments were then altered in the following manner: Agitate separate portions of the five sulphides with 0.2% solution of potassium permanganate for one minute. Then add 0.1% of wood-creosote, pine-oil, or pine-tar, and re-agitate for one minute. The potentials of the sulphide particles approached zero. Oil will not adhere to the sulphide particles, which have been subjected to agitation with 0.2% solution of potassium permanganate for one minute previous to the addition of the oil.

Five tests were undertaken in 0.2% potassium permanganate solution. The potentials of the sulphides approached zero. Fifteen tests were undertaken in a solution, consisting of 0.2% of potassium permanganate and 0.1% of wood-creosote, pine-oil, or pine-tar. The potentials of the sulphides did not approach zero. Fifteen tests were under undertaken, where the sulphide particles were agitated for one minute with 0.2% potassium permanganate solution; then 0.1% of wood-creosote, pine-oil, or pine-tar was added, and the agitation continued for one minute after the addition of the oil. The potentials of the sulphides approached zero. These experiments prove, as with the members of the potential series, that an ionic chemical reaction is retarded between an oil-filmed sulphide particle and an electrolyte.

Reduce the potentials of the five sulphides to apparent zero with 0.2% solution of potassium permanganate. Wash thoroughly with distilled water and compare their lustres with those of the particles agitated with distilled water. Re-immerse the sulphide particles whose potentials are at apparent zero, in 0.2% sulphur dioxide water at 20°C. Agitate for one minute. The potentials are restored to their original values. Repeat these experiments in sulphuretted-hydrogen water (1 cc. of saturated sulphuretted-hydrogen water to 20 cc. of distilled water) and the potentials are restored on the sulphide particles as with sulphur dioxide. Wash thoroughly with distilled water and compare the metallic lustres with those of the particles agitated for one minute in distilled water. The lustres are apparently identical. Pyrite, which possessed a very deep and brassy metallic lustre when agitated for one minute with 0.2% solution of potassium permanganate, possessed an almost white metallic lustre, when re-agitated with sulphur-dioxide water. In these experiments the potentials were lowered to apparently zero with an oxidizer, and then restored to their original values by re-agitating with reducers. The metallic lustres were changed by agitating with an oxidizer and then restored by re-agitating with reducers.

The potentials of pyrite and galena, when agitated for one minute at 10° and 20°C. with 0.1% solution of copper sulphate, approached zero. The potentials were raised to their original values by re-agitating in 0.2% sulphur-dioxide and sulphuretted-hydrogen water. A 0.1% solution of copper sulphate failed to lower the potential of sphalerite. After three hours submergence in the solution, the potential of sphalerite was not lowered.

Generally speaking, a one-minute agitation test will prove whether an electrolyte is detrimental or not to the potential of a sulphide. A notable exception to this rule is molybdenite.

Sodium sulphide was a dismal failure when tested on the largest particles possible to float economically. It is possible with a 0.1% solution of sodium sulphide to restore the original metallic lustre of pyrite, which had been previously altered with 0.2% solution of potassium permanganate, but the potential on the sulphide particles for some reason is not restored. An interesting experiment is as follows: Prepare a sample of silver particles. Agitate two equal parts of these, one in 0.1% solution of sodium sulphide and the other in sulphuretted-hydrogen water. They both are filmed apparently with silver sulphide, but the one agitated with sodium sulphide possesses a potential approaching zero, whereas the silver particles agitated with sulphuretted hydrogen have a high potential. Changing to a different sample of chemically-pure silver and to sodium sulphide manufactured by a different chemical company did not alter the results. The silver particles filmed with the solution of sodium sulphide were washed thoroughly with sulphuretted-hydrogen water. Then on immersing in sulphuretted-hydrogen water, the potentials of the silver particles agitated with solution of sodium sulphide were not restored. The chemical action of sulphuretted hydrogen and sodium sulphide is entirely different in artificially-prepared electrolytes. In a complicated electrolyte in a mill, the chemical action may be the same.

In a 0.1% solution of copper sulphate particles of copper and silver do not lose their potentials, whereas particles of zinc readily turn black, due to the precipitation of films of copper, and lose their potentials.

CONCLUSION. The following physical conditions should be constant in these tests: diameter of the bubble, depth in the electrolyte at which the bubbles are produced, temperature, size of the sulphide particles, and time of agitation. The angle of contact between a metallic surface and a bubble has an important rôle in flotation. By condensing bubbles on plane, convex, and concave surfaces of the metals this may be proved. Concave surfaces possess this property to a marked degree.

Oil, as used in the flotation process, has three distinct physical properties:

1. By lowering the surface-tension of water, it permits the formation of a permanent bubble at the air-solution interface.

2. The adhesive force between a metallic surface and oil is greater than the adhesive force between a metallic surface and water.

3. The potential tends to remain constant on an oil-filmed metallic surface, either metallic or sulphidic, provided the surface is subject to chemical changes.

An ionic chemical reaction cannot take place without the presence of water. The chemical reactions taking place in the flotation process are ionic and not thermal.

"The oxidation of any substance may consist in the addition of atoms of a negative element to its molecules ($4FeO + O_2 \rightarrow 2Fe_2O_3$), atoms ($2Fe + 3Cl_2 \rightarrow 2FeCl_3$), or ions ($SO_3 + O \rightarrow SO_4$); or in the withdrawal of atoms of a positive element; or it may consist in the addition of positive charges of electricity, or in the withdrawal of negative charges. Reduction is the reverse of this, namely, the addition of the atoms of positive elements or of negative electrical charges, or the withdrawal of the atoms of negative elements, or of positive electrical charges. The oxidation of one substance always involves the simultaneous reduction of some other substance, and vice versa."*

Is oil necessary in the flotation process? This depends soley on the lowering of the potential—the rapidity and degree of oxidation. Sulphides have been floated successfully in electrolytes to which reducers have been added, without the use of oil. Simplicity and economy determine the use of oil in the flotation process; potassium permanganate, as used in selective flotation, increases the difference between the potentials of two or more different sulphides.

In all probability the theoretical law of condensation of gases on metallic surfaces is as follows: The members of the potential series condense gases on their surfaces directly as the intensity of their potentials, but inversely as the power to lower their potentials. Platinum and palladium, whose potentials remain constant or tend to do so at normal temperatures, are notable for their ability to condense gases when in a finely divided or porous state. The potentials of platinum and palladium are very low. Porous carbon (charcoal), a member of the potential series, but generally not classed as a metal, also possesses to a high degree the power to condense gases, when in a finely-divided state. The potential of carbon also remains constant or tends to do so at normal temperatures. The sulphides should condense gases and float, directly as the intensity of their potentials, but inversely as the power to lower their potentials. As with metals, high potentials on sulphides are lowered readily.

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*Noyes, 'Qualitative Analysis', p. 39.

Recovering Zinc Used in Cyanidation

*Metallic zinc is used on the Witwatersrand to precipitate the gold from cyanide solution. The so-called zinc slime obtained during the process consists of metallic gold in finely-divided form, unattacked zinc, and insoluble zinc compounds. The mass is treated with sulphuric acid solution or with solution of acid sodium sulphate. The gold remains unchanged, but the zinc passes into solution.

A small plant for the recovery of the zinc in a useful form by a method known as the Kominsky process has been started at Germiston, where efforts are being made to obtain the zinc in the form of paint-pigments. The solution contains, as a rule, zinc salts equivalent to about 5% of metallic zinc; in addition, it always contains a small amount of iron salts which are present mostly in the ferrous condition; the solution is always acid. For the production of zinc paint-pigments it is necessary to remove the iron from the solution, because if this is not done it would find its way into the precipitated zinc compounds and would cause discoloration. The removal of the iron has been made possible by the Kominsky process. At the Germiston works the first step in the process is the control of the acidity of the solution. If the solution is too acid the acidity is reduced by the addition of lime, but care must be exercised that the acidity is not reduced too much. The iron in the solution is then completely converted into the ferric condition by the addition of a solution of sodium chromate. As the ferrous iron is oxidized to the ferric state the chromate (or bichromate, because the reaction takes place in a slightly acid solution) is reduced so that the solution now contains, in addition to sodium salts, zinc sulphate, ferric sulphate, and chromium sulphate. It is not advisable to use excess of sodium chromate.

To a small proportion of the original solution the requisite quantity (but no excess) of a solution of sodium hydroxide is added. This precipitates impure zinc hydroxide; this is made into a thin paste, which is now added to the fully oxidized solution. The zinc hydroxide is added in considerable excess. The first action is that of the excess of acid present on the suspended zinc hydroxide, whereby the solution is neutralized and a quantity of zinc sulphate equivalent to the free sulphate equivalent to the free sulphuric acid present is produced and passes into solution. The zinc hydroxide then reacts in the neutral solution with the ferric and chromium sulphates, producing (1) insoluble ferric and chromium hydroxides which separate from the solution and (2) an equivalent quantity of zinc sulphate, which passes into solution. The fluid is then filtered; the clear filtrate obtained is a neutral solution of zinc sulphate and sodium sulphate. The sludge in the filter-press contains excess of zinc hydroxide mixed with the hydroxides of iron and chromium, and can be re-used as a precipitating agent until the zinc hydroxide is almost exhausted.

The clarified solution containing zinc and sodium sulphates is now in a condition to be precipitated. The precipitation may be effected by means of a solution of sodium carbonate, whereby insoluble (basic) zinc carbonate is deposited, or by means of solution of sodium chromate in which case insoluble zinc chromate separates. The insoluble zinc salt is washed with water to remove all sodium salts, and is then separated in a filter-press. The sludge in the filter-press is dried.

The dried zinc chromate obtained in this way requires only to be crushed and sieved to be ready for use as a paint-pigment—zinc-yellow. To make zinc-white (zinc oxide) the dried basic carbonate need be calcined in a calcining furnace; and in order to make a satisfactory paint-pigment, the calcined mass must be finely ground and sieved.

The processes in use at the Germiston works are simple, and no difficulty has been experienced. The scheme possesses the advantage that if any of the reacting substances is added in excess the inadvertence may readily be corrected. The present capacity of the plant allows of the production of about 2½ tons of paint-pigment per day of twenty-four hours. The raw material is a solution; and, as the products aimed at are insoluble, only precipitation methods are used; consequently the products are separated by the filter-press, and expensive evaporations are avoided.

The cost of the process will be determined largely by: (*a*) transport of the zinc-slime solution to the plant; (*b*) cost of sodium chromate and sodium carbonate.

A by-product sodium sulphate in the form of a solution will be obtained. Recovery of this will entail evaporation, or evaporation and refrigeration.

On the assumption that the zinc-slime solution obtained from the gold mines contains zinc salts equivalent to 5% of metallic zinc, each gallon of the solution would contain ½ lb. zinc, and from this would be obtained 1.38 lb zinc chromate (zinc-yellow) with the aid of 1.25 lb. of sodium chromate. Or, if the zinc-white (zinc oxide) were made, then for each gallon of solution 0.81 lb. of sodium carbonate would be required and 0.96 lb. of zinc carbonate would be obtained, which would yield 0.62 lb. of zinc-white.

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*Abstracted from the 'South African Journal of Industries'.

Accident Prevention at the Calumet & Arizona Mines and Smelter

By A. W. Allen

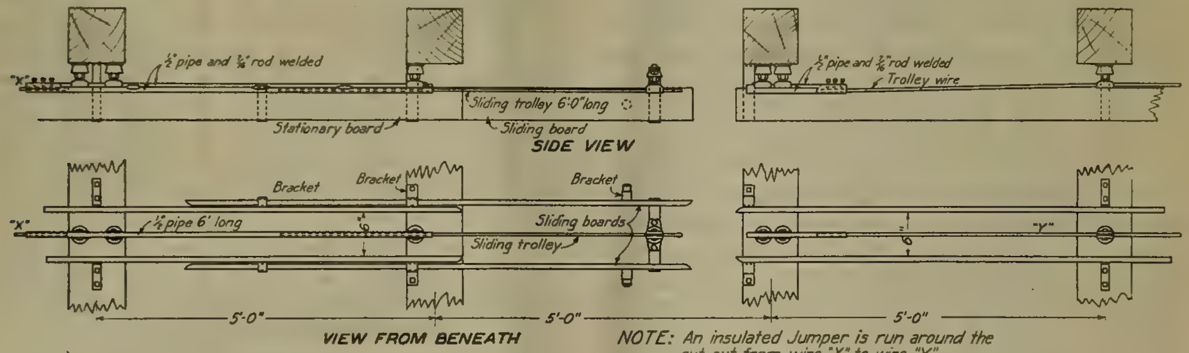
Accident prevention has a greater significance than is generally recognized; the safety-first movement is more than something to prevent mishaps or to reduce disability and suffering and unemployment; its success must inevitably affect the economic life of the mining industry, for the fear of accident, injury, and incapacitation often causes more harm to the community than does the single accident that may happen to an individual miner. Statistics in connection with the coal strike in Great Britain during the early part of last year have revealed a most significant fact: in the ballot for and against the strike, the votes in favor were exactly in proportion to the death-rate at the mines in which the men worked. Where the death-rate was high, the number of votes in favor of the strike was proportionately high; where the death-rate was small, a great majority of the voters were against the strike. This was not the result of a series of coincidences; for when the men were called upon to vote on the question of returning to work it was noticeable that exactly the same influences swayed their decisions. Those whose duties took them to a mine with a low death-rate were anxious that the strike should end; those who were obliged to face a proportionately greater amount of danger underground elsewhere were in favor of its continuance. The conclusion is inescapable. Unchecked carelessness and frequent accidents are the cause of much industrial waste, which cannot be estimated in terms of the monetary loss and disorganization that arise from crushed toes or broken arms. Mining was discredited until comparatively recent times because of a lack of systematized measures for the prevention of accidents. The safety-first movement has shown that a reduced death-rate is by no means the most important result achieved; other sequences, the connection of which with their *raison d'etre* is often unsuspected, are of considerable value in helping to avoid disorganization and in furthering general industrial efficiency.

The subject of accident prevention has received increasing attention during recent years; the safety-first movement has been promoted in various ways, chiefly by means of influences that made the most of moral suasion. It was recognized at first that the employer was largely to blame; but even after every precaution had been taken by him, after every conceivable safety device had been devised and installed, accidents continued to occur. Educational methods were then intensified, and every possible effort was made to demonstrate the advantages of care and prudence, and the futility and wastefulness of an attitude that neglected to take reasonable precautions against personal injury. A workman is now selected for his particular task with greater care than formerly; he is assigned, so far as practicable, to duties that are congenial to his taste and that suit his mental and physical qualifications. Steps have been taken to enforce codes of rules that have been drawn up to minimize, if not to prevent, the occurrence of accidents; and no effort has been spared to demonstrate to the men the benefits that would accrue to all concerned by the practice of foresight and common-sense. The standardization of equipment to prevent accidents has progressed in harmony with its demand, which, in turn, has risen in appreciation of the benefits accruing from its use. The safety engineer has become an integral part of the modern industrial machine, especially in connection with mining operations. The provision of safe conditions and the designing of fool-proof equipment have reached a stage that a decade ago would have been considered meticulous; but results are daily proving the wisdom of the precautions taken and the ultimate return for the money and labor expended, which is always considerable at the commencement of such a campaign as the one that counsels 'safety first'.

It is interesting to review the progress of the movement and to note the value of a high ideal of attainment. When the work was commenced in earnest it was considered that accidents, like the poor, must always be with us. It was not thought feasible to avoid injury and accidental mortality altogether, and so only a lukewarm appreciation of the possibilities of the new movement was accorded by many who should have been enthusiastic. In recent years, however, an ideal has been preached—the entire abolition of accidents. This, like the millenium, may never be reached; but the earnest efforts of those who are sponsoring the movement are such that the results being obtained are extraordinarily good; they prove the advantage of aiming at a high pitch of achievement, even though to the majority the goal may seem unattainable. Concurrently with the systematizing of safety work has come an opportunity to study cause and effect, and to differentiate between minor accidents and serious injuries. At one time it was customary to blame everything on the worker; it was claimed that his neglect and stupidity were responsible for a preponderating proportion of the accidents that occurred. It was found, however, that although carelessness was an influencing factor, much was due to neglect on the part of employers, who often failed to make adequate provision against mishaps that lead to loss of life or limb. Then came a period during which the importance of mechanical provision to ensure immunity from accidents held the stage, and today most of the standard equipment in use has safety-first provisions incorporated in its design and included in its construction. In spite of this, however, accidents will occur. It has been said of a certain type of workman that freedom from accident or mishap could not be guaranteed unless he were placed in a padded cell in a bomb-proof shelter in the centre of a large field; but even then it is probable that he would stub his toe against the entrance or fall down the steps, to the end that blame might fall on the safety engineer who designed the shelter. In the majority of mines and plants that are operating today everything possible is being done to prevent accident, not altogether from altruistic motives, or entirely because of a desire to lessen suffering, but because freedom from interruption aids efficiency, and anything that aids efficiency is good business and must be based on commonsense. The problem is now one of driving home to the men the truism that the avoidance of accident must inevitably redound to their own ultimate advantage; of insisting on a recognition of the fact that the great majority of accidents are preventable; and of seeing that no scruples are allowed to stand in the way of attaining immunity from major disasters, if not altogether from minor injuries.

When in Arizona recently I had the privilege of discussing with Mr. Thomas Cowperthwaite the safety organization under his control, and the methods used to promote and to sustain interest in the safety-first movement among the shift-bosses and foremen of the Calumet & Arizona Mining Co. The initial step was taken in February 1915, when Col. John C. Greenway, the general manager for the company, decided that a safety department should be formed, to reduce accidents at the company's mines at Bisbee; at the smelter and acid plant at Douglas; and at the mines and leaching plant of the subsidiary company, the New Cornelia, at Ajo. Mr. Cowperthwaite, himself a mining engineer and a member of the engineering department of the parent company, was appointed to take charge. Visits were then made to other mining districts in the State, with the idea of obtaining information as to suitable methods to adopt in order to achieve the desired results, but the mission proved unfruitful. Mr. Cowperthwaite was obliged to rely almost entirely on his own initiative in the matter; this involved a careful preliminary consideration of all the factors involved, particularly in connection with the attitude with which the safety movement was being viewed by the employees as a whole. A plan of action was then formulated, Mr. Cowperthwaite and his secretary comprising the staff of the safety department, the safety inspector being responsible to the manager alone; a safety committee was then appointed, comprising all the shift-bosses, foremen, and superintendents, each of whom was thereafter held responsible for the safety of the men working under him. No distinction was made between accidents resulting from so-called unavoidable causes, want of care, and neglect of precautions; the shift-boss or foreman was liable, whatever the cause of the mishap. The next step taken was to inculcate a spirit of friendly rivalry among those in responsible positions. This was achieved in a number of ways. Meetings were held at monthly intervals, at which members of the safety committee were obliged to attend, on company's time. Discussions were encouraged on the question of accident prevention, and reports were read that detailed each mishap during the recess; blame was apportioned where justified, and suggestions were made and criticized as to remedial measures. The first result of these meetings was that the safety inspector was enabled to distinguish those who were in sympathy with the movement from those who were either openly antagonistic or merely apathetic. This step ensured co-operation, not only between the safety inspector and his committee, but among the shift-bosses and foremen themselves; but the motive that prompted them to be enthusiastic was recognized as insufficiently strong. Competition between shift-bosses was then encouraged, and advantage taken of the feelings of pride and achievement that were evinced by those bosses who had done well during the preceding month and who had been able to present a record free from the blemish of even a minor accident. This element of competition served its purpose, but it lacked a definite statistical basis; and so, concurrently, Mr. Cowperthwaite devised a scheme of accident accounting, by which the shift-bosses and foremen would each be accorded a definite status month by month, on a numerical basis, by which the degree of zeal evinced by each could be adjudged correctly, and without fear of contradiction. By this scheme a competitive spirit could be heartened by actual evidence that accidents can be reduced to an insignificant number, if not avoided altogether. A move was then made to foster enthusiasm for the scheme and to afford a convincing method of showing the shift-boss and the foreman that care and precaution was worth while; and, furthermore, that only one case of neglect to maintain the standard, which it was proved was no difficult matter to maintain, meant what few of us are able to view with composure—a loss of hard cash. Mr. Cowperthwaite's plan has the merit of simplicity; it has been devised on equitable principles. The comparative results obtainable are indicative of the individual care and pride taken by each boss in this most important phase of his work; they are convincing.

The scheme is based on the idea that a reward shall go to the boss who can show an immunity from serious accident among his subordinates for a certain number of man-shifts. A bonus of $30 is payable to each and every boss whose records show that he has been responsible for 2500 man-shifts of work being performed without the occurrence of an injury that involves more than the loss of one day from duty. Thus a boss with 50 men must avoid the reporting for 50 shifts of an injury of this kind. If an accident occur his record is readjusted, and a definite number of points subtracted, depending on the nature of the accident. In addition, a foreman with the best yearly record is rewarded with a bonus of $100. The amounts payable as bonuses are not princely, but they are sufficient to foster a degree of enthusiasm that otherwise would be absent. Accidents are divided into two classes, serious and minor. A serious accident is considered as one that necessitates absence from work for 14 days or more; a minor accident is one that involves incapacitation for a period over one and less than 14 days. Under the system described the boss is anxious to get his men back to work as quickly as possible after an accident. If only one day be lost the boss is not penalized; he sees to it that malingering is not attempted, so that his records can be maintained. Thus it is that an employee who exaggerates the seriousness of a scratch is unable 'to get away with it', so long as the boss has any say in the matter. A major accident among his men results in the loss of 6 points; thus it is that the boss exerts every effort so that his men return to work within 14 days from the date of the accident. To avoid unnecessary periods of convalescence it was been found profitable to allow an injured man to take up light work until he is strong enough to resume his ordinary duties. This plan benefits all concerned. It discourages malingering, and ensures a better watch being kept on the injured man and a more satisfactory control by the medical authorities, of his physical condition. Moreover, the employee receives, while doing such work, his full pay, whereas under the State compensation law of Arizona he would be entitled to only half-pay for time lost, due to the accident, after 14 days of disability; and to nothing at all if away from work for any time under 14 days. Fatal accidents, it is gratifying to be able to state, are becoming increasingly rare in the Calumet & Arizona company's mines. The boss is mulcted heavily if such occur among one of his own men. If the accident be caused by his own neglect, 25 points are deducted from his record; if the employee was himself to blame, 12 points are deducted. The system is cumulative in its efforts to encourage carefulness and zeal. As his total nears the 2500 mark, the boss realizes the importance of increased watchfulness, in order that the coveted bonus does not slip through his fingers as a result of one eleventh-hour minor accident; similarly, the monthly reports that are issued to all foremen indicate how each stands for the $100 yearly bonus. The advantages of these inducements is that they lead to the formation of habit; and, as we all know, habit is the most difficult thing to eradicate.



NOTE: An insulated Jumper is run around the cut-out from wire "X" to wire "Y".

Small boards are hung from lag-screws on 10" by 10" caps to drop down over dead ends when cut-out is open.

DETAILS OF SAFETY-TROLLEY CUT-OUT, USED IN THE MINES OF THE CALUMET & ARIZONA MINING COMPANY

A considerable amount of enthusiasm is needed to counteract the open hostility or veiled apathy that greets the sponsor of any new movement, especially when it is capable of being interpreted as a paternalistic interference with the so-called right of every man to act as he pleases. The systematic manner in which the safety movement at the Calumet & Arizona properties has been handled has resulted in an early appreciation by the men themselves of the ease with which the recommendations can be put into practice, and the favorable results that can be obtained by co-operation. The observance of safety-first rules is now becoming a habit. Those who only a few years ago openly derided such propaganda have been converted by the moral pressure of their associates' opinions; those who were apathetic, and who exclaimed "What's the use?", have realized that they were missing a tangible reward that could be earned by the exercise of a little care and a little caution. Another distinctive advantage of the scheme is that the zealous boss knows where he stands; the monthly report is an evidence of attention to an important phase of his work. The careless or unbelieving associate may endeavor to shield his own unsatisfactory showing by a hard-luck story of an unfortunate succession of unpreventable causes that led to his low place on the list. Such excuses serve once, sometimes twice, but never more. The ultimate query of the safety inspector is, "If the other bosses can show a continued improvement, why can't you?" The conclusion is inevitable. The one who has failed to gain the requisite number of marks sees that he must quit or mend his ways. In order to insist that the safety-rules are observed it was found desirable, at the commencement of the experiment, to introduce what was known as the lay-off system, whereby any miner who was found to neglect safety precautions was discharged temporarily, being allowed to return to work after the lapse of 2 to 14 days, according to the degree of the carelessness or callousness shown. The importance of making definite progress was realized; it was considered that, so far as the prevention of accident was concerned, the end justified the means taken to secure it; nothing was allowed to stand in the way of improved conditions underground. The men were told that the company officials insisted on the observance of the elementary rules of safety; if they were laid off for carelessness they had only themselves to blame; the shift-bosses were in no way responsible for the regulation. The men were also told that it was their duty to report to the safety inspector any condition that should be remedied; and that all information of this kind, from whatever source, that might implicate others would be considered as confidential, the identity of the informant remaining undisclosed.

Carelessness breeds a contempt for danger that invariably brings its own consequences and its own lessons. A strict observance of safety-first principles tends to the formation of orderly habits; a miner who has become a convert to the new movement has, perhaps unknown to himself, acquired a habit of making mental comparisons. It becomes second nature to him to report to the safety inspector a condition underground that constitutes a menace to the safety of others. Another important feature of the scheme is that it places the stamp of approval or of disapproval on a mine-foreman or shift-boss, who now finds that his chances of obtaining a position of greater responsibility and more pay are considerably better if his accident-record papers indicate a freedom from the mishaps that too often serve to identify the careless and the ignorant. The unfortunate boss who maintains that he is the victim of hard luck, who argues that things always go wrong with him and who blames his subordinates, finds that he must subscribe to the new order or get out; for none is more dangerous than the one who pretends that some unseen force is working against him to balk his efforts to manage and control the men and machinery in his charge.

The system of the numerical appraisal of merit, as proposed by Mr. Cowperthwaite and in use in safety organization of the Calumet & Arizona and allied companies, has proved entirely successful, and so merits a wider appreciation. As an example of how the scheme may be applied, there is reproduced herewith, thanks to the courtesy of the general manager of the company, an abstract from the statement for November 1921, a copy of which is given to each shift-boss and foreman. That the adjudication of zeal and merit is a fair one is generally recognized; and this has been followed by a degree of co-operation that has led to a substantial diminution in the number of accidents occurring in the company's mines; serious accidents have been reduced by 54.4% since the inception of the safety-first movement in 1915.

Accidents Reported

	November 1920		October 1921		November 1921	
	Number	% of total	Number	% of total	Number	% of total
Total accidents	33		15		17	
Fatal accidents	0	0.0	1	6.6	0	0.0
Serious accidents:						
Underground	3	9.1	0	0.0	2	11.8
Surface	2	6.1	1	6.6	1	5.9
Minor accidents	8	24.2	3	20.0	2	11.8
No-time-off accidents	20	60.6	10	66.8	12	70.5

Standing of Shift-Bosses and Foremen for November 1921

Shift-boss	Mine or department	Number of man-shifts	Number of accidents Serious	Number of accidents Minor	Accidents per 1000 man-shifts Serious	Accidents per 1000 man-shifts Minor	Efficiency rating
A	Junction	1293	0	0	0	0	100.0
B	Junction	799	0	0	0	0	100.0
C	Junction	670	0	0	0	0	100.0
D	Junction	659	0	0	0	0	100.0
E	Junction	609	0	0	0	0	100.0
F	Briggs	420	0	0	0	0	100.0
G	Junction	276	0	0	0	0	100.0
H	Cole No. 3	191	0	0	0	0	100.0
I	Briggs	35	0	0	0	0	100.0
J	Junction	256	0	1	0	4.0	96.0
K	Briggs	850	1	1	1.2	1.2	91.74
L	Junction	249	1	0	4.0	0	75.9
Shift-foreman							
V	Cole No. 3	281	0	0	0	0	100.0
X	Junction	4538	1	1	0.2	0.2	98.46
Y	Mechanical	2719	1	0	0.4	0.0	97.78
Z	Briggs	2328	1	1	0.4	0.4	96.99

Standing of Shift-Bosses and Foremen, January to November, Inclusive

Shift-boss	Mine or department	Number of man-shifts	Number of accidents Fatal	Number of accidents Serious	Number of accidents Minor	Accidents per 1000 man-shifts Fatal	Accidents per 1000 man-shifts Serious	Accidents per 1000 man-shifts Minor	Efficiency rating
F	Briggs	9,515	0	0	1	0	0	0.11	99.89
J	Junction	3,954	0	0	2	0	0	0.51	99.49
B	Junction	7,697	0	1	0	0	0.13	0.00	99.22
C	Junction	9,930	0	4	2	0	0.40	0.20	99.00
D	Junction	6,976	0	1	1	0	0.14	0.14	99.02
E	Junction	5,490	0	1	0	0	0.18	0.00	98.92
K	Briggs	9,636	0	1	5	0	0.10	0.52	98.86
A	Junction	10,374	0	2	1	0	0.19	0.09	98.75
I	Briggs	3,329	0	1	1	0	0.30	0.30	97.90
G	Junction	4,340	0	2	1	0	0.46	0.23	97.01
H	Cole No. 3	4,832	1	4	2	0.2	0.82	0.41	92.27
Shift-foremen									
Y	Mechanical	37,082	0	4	10	0	0.11	0.27	99.07
Z	Briggs	34,112	0	6	9	0	0.18	0.26	98.68
X	Junction	65,598	0	23	14	0	0.35	0.21	97.69
V	Cole No. 3	14,366	1	5	3	0.07	0.35	0.21	96.85

Serious (Including Fatal) Accidents

Mine	Foreman	Accident rate per 1000 man-shifts Nov. 1920	Accident rate per 1000 man-shifts Oct. 1921	Accident rate per 1000 man-shifts Nov. 1921
Briggs	Z	0.0	0.0	0.43
Junction	X	0.3	0.0	0.22
Cole No. 3	V	0.0	3.4	0.00
Total mines		0.19	0.14	0.28
Mechanical department	Y	0.25	0.36	0.37
Mexican department	U	0.95	0.00	0.00
General		0.00	0.00	0.00
Total		0.22	0.17	0.26

Total Accidents

Mine	Foreman	Accident rate per 1000 man-shifts Nov. 1920	Accident rate per 1000 man-shifts Oct. 1921	Accident rate per 1000 man-shifts Nov. 1921
Briggs	Z	1.33	1.74	2.15
Junction	X	2.01	1.27	1.54
Campbell	V	0.00	0.00	0.00
Cole No. 3	V	0.00	3.37	0.00
Total mines		1.72	1.50	1.82
Mechanical department	Y	0.51	1.46	1.10
Mexican department	U	3.81	0.00	0.00
General		0.00	0.00	0.86
Total		1.48	1.28	1.49

Serious Accident Rate (Including Fatal) Per 1000 Man-Shifts for First Eleven Months of 1920 and 1921, Respectively

Mine	Foreman	1920	1921	Decrease or increase 1921 over 1920, %
Briggs	Z	0.10	0.17	70
Junction	X	0.43	0.31	**28**
Campbell Air Shaft Cole No. 3	V	0.80	0.86	7.5
Total mines		0.31	0.30	3.2
Mechanical department	Y	0.09	0.12	33
Mexican department	U	0.17	0.00	**100**
Office departments		0.05	0.00	**100**
Total		0.25	0.23	**8**

Total Accident Rate Per 1000 Man-Shifts for First Eleven Months of 1920 and 1921, Respectively

Mine	Foreman	1920	1921	Decrease or increase 1921 over 1920, %
Briggs	Z	1.63	1.70	4.3
Junction	X	2.45	1.62	**34.0**
Campbell Air Shaft Cole No 3	V	1.34	2.60	94.0
Total mines		2.13	1.69	**20.0**
Mechanical department	Y	1.10	0.91	**17.0**
Mexican department	U	1.41	1.05	**25.0**
General		0.13	0.19	46.0
Total		1.78	1.40	**21.0**

Classification of Accidents, November 1921

	Cole No. 3			Briggs			Junction			Total		
Mine Department	Serious	Minor	No-time-off	Serious	Minor	No-time-off	Serious	Minor	No-time-off	Serious	Minor	No-time-off
Falling ground	0	0	0	0	1	0	0	0	1	0	1	1
Handling tools	0	0	0	0	0	1	0	0	0	0	0	1
Strains and sprains	0	0	0	1	0	1	0	0	0	1	0	1
Dirt in eyes	0	0	0	0	0	1	0	0	3	0	0	4
Miscellaneous	0	0	1	0	0	0	1	1	1	1	1	2
Total	0	0	1	1	1	3	1	1	5	2	2	9
Mechanical Department												
Foreign body in eye	0	0	0	0	0	0	0	0	0	1	1	0
Cut from flying objects	0	0	0	0	0	0	0	0	0	0	0	1
Dirt in eyes	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	0	0	0	0	0	0	1	1	2
Total, all departments	0	0	0	1	1	3	1	1	5	3	3	11

The serious accidents for November were caused as follows: Briggs mine, 'K' shift-boss: 'P' lifted lagging to lower timbers to stope and stepped in hole; off 34 days. Junction mine, 'L' shift-boss; 'Q' was passing up staging and slipped off platform; off 20 days. Mechanical department, 'M' foreman; 'R' received hot scale in eye; off 16 days.

A LARGE portion of the mineral production of Canada is exported for consumption or refining elsewhere, states the annual report of the Department of Mines. On the other hand considerable quantities of mine products, chiefly those that have been refined or are subject to part treatment, or in the form of manufactured goods ready for consumption, are imported. The total value of the exports of mineral products, including direct mine products and manufactures thereof, in 1920, was $193,420,702, compared with $179,957,897 in 1919, according to records compiled from the Monthly Reports of the Trade of Canada published by the Department of Trade and Commerce. Of the total exports in 1920, about $60,000,000 can be attributed to metals either in crude or refined metallic form or contained in ores or some form of metallurgical product exported for further refining. About $38,000,000 is attributed to asbestos, coal, mica, and various other non-metallic minerals. About $12,000,000 is attributed to chemical products such as cyanamid, calcium carbide, and ammonium sulphate. The balance, over $83,000,000, is made up largely of manufactured products, chiefly manufacturers of iron and steel, such as agricultural implements, machinery, boilers and locomotives, rolling-mill products, and wire. A great variety of mineral products, chiefly in the manufactured or semi-manufactured condition, are imported into Canada. These imports increased in value with great rapidity during the ten years preceding 1913. During the next two years, however, there was a reduction, but in 1916 the imports again increased to a value almost equal to that of 1913. The total value of these imports during the calendar year 1920 amounted to $482,060,739, as compared with a value of $326,468,755 in 1919. Of the total value of these imports in 1920, over one-half, valued at about $250,000,000, consisted of iron and steel goods, and about 29%, valued at over $151,000,000, of coal, coke, and petroleum.

Eyesight of Miners

In a paper on sight efficiency, J. Kirk, in a recent issue of the 'British Medical Journal', records the results observed from the beginning of December 1917 to the signing of the Armistice in November 1918, while acting as the ophthalmic specialist to the National Service Recruiting Boards for the Edinburgh district. One conclusion he arrives at is that myopia is essentially a disease of town dwellers and of industrial life. Of the myopics 77.4% belonged to the industrial classes, and comprised all varieties of occupations. The miners headed the list with 28.4% of the total. Young apprentice engineers seem to suffer unduly from myopic error, and Dr. Kirk was most struck with its development among young miners from 18 to 25. This showed itself first generally as a simple astigmatism gradually developing into the compound variety. Myopia, as opposed to hypermetropia, is essentially a disease, and therefore should be, and can be, prevented in the great majority of cases. Several thousand young miners in this district were called up for active service after the German advance in March 1918. Their average age was 21; and the result of his examination showed that at that age in this district miners' nystagmus is uncommon; Dr. Kirk found only three cases. There were, however, 142 cases of myopia. Of this number 36.6% had simple regular astigmatism. The peculiar strain of the miner's occupation, therefore, may result in the development in the young miner of myopic astigmatism. This later becomes compound, and nystagmus often follows in more mature years. The sequence, therefore, in many cases of miners' nystagmus is, first, severe muscular strain, development of myopic astigmatism, defective illumination, interference with normal fixation, and an ensuing nystagmus, varying in amount according to the general health and influence of intercurrent disease. The influence of refractive errors on miner's nystagmus has been often discussed, but Dr. Kirk does not think that the point that the miner's occupation is often in itself a cause of the initial refractive error has been advanced before. His experience with many young miners has persuaded him that the beginning of the trouble may be accompanied, either as a casual or pre-disposing factor, by the development of a low degree of simple myopic astigmatism, which develops later into the compound variety; and that this astigmatism appears to follow the peculiar strain on the eye structures resulting from the miner's occupation.

CHILEAN manufacturing plants in 1918 numbered about 6700. According to the Bureau of Foreign and Domestic Commerce, 2820 of these, with 168,081 hp., had a total of 20,624 machines.

The Mining Law and the Geologist

By C. K. Leith

*In the United States there is a wide use of geologists as witnesses in litigation affecting extra-lateral rights. The federal mining law gives the owner of the claim containing the apex or top of a mineral vein or lode the right to follow the vein down the dip, with certain limitations, even though this takes him on to adjacent properties under other ownership. Where two branches of a vein are followed down from separate claims, the owner of the oldest claim is entitled to the vein below the point of junction. The law was framed to validate a procedure more or less established by mining custom. It was obviously framed with a very simple and precise conception in mind—namely, a simple vein definitely and easily followed, without much interruption or contortion.

In nature, however, veins or lodes have a most astonishing variety of form and occurrence, making it difficult to frame a definition that is comprehensive and at the same time sufficiently precise for all cases. A commonly used definition of a vein or lode is a mineralized mass of rock which is followed for purposes of finding ore. The mineral matter may be continuous or discontinuous. There may be one definite wall, or two walls, or none at all. There may be associated gouges and altered or mineralized rock. The vein may consist of almost any combination of the elements of mineral matter, walls, gouges, and mineralized rock. Instead of being a simple tabular sheet, a vein may have almost any conceivable shape; it may consist of multiple strands of most complex relations; it may have branches and cross-over connections. It may be a more or less mineralized sedimentary formation with limits determined by original deposition. It is very often bent or folded, and even more often faulted; the faulting may be of great complexity, making it extremely difficult to follow the vein. The vein may be cut by other veins of different ages, which in places may be hard to distinguish one from another. Erosion working down on a complex vein displaced by faulting and folding may bring several parts of the same vein to the surface, developing what seem to be separate vein apices. Where there are many veins close together, it may be difficult to determine whether the entire mass should be considered a unit vein or lode (a "broad lode"), or whether each vein should be considered independently under the law.

The geologic aspects of these problems are obvious. There are few mining districts where the vein conditions are so simple that no geological problems are left to be solved with relation to extra-lateral rights. In the early stages of the mining, separate operations may be carried on for a considerable time in a district without mutual interference; but as mining is carried down the dip, what seemed to be separate veins may be found to be parts of the same vein or parts of a complex vein system, and separate mining organizations are thus brought into conflict. It then becomes necessary to consolidate the ownerships or to go to the courts to see which claim has the extra-lateral rights. In either case, the geologist is called on to play a large part—in the valuation of rights for the purpose of combination, or in litigation to settle apex rights. A geologic survey of the conditions is a prerequisite. In order to get the needed information for the court-room, it may be necessary to go further, and to conduct extensive underground exploration under geologic direction. Some of the most intensive and complete geological surveys of mineral resources in existence have been done for litigation purposes. The study in these cases is not empirical, but goes into every conceivable scientific aspect of the situation which may throw any light on the underground conditions—the source of the ores, the nature and source of the solutions which deposited them, their paths of travel, the structural and metamorphic conditions, the mineralogical and chemical character of the ores and rocks, and even broader questions of geologic age. The many volumes of testimony which have accumulated during famous apex trials cover almost every phase of geology, and are important primary sources for the student of economic geology.

It is often argued that strictly scientific, impartial geologic work is impossible in connection with one of these trials, because the viewpoint is warped by the desire to win. The sharp contrast in the views of experts on the two sides is cited in evidence.

There is no denying the fact that the conditions of a trial tend toward a certain warp in scientific perspective. On the other hand, the very existence of competitive and opposing interests leads to the most intensive detailed study, and to complete disclosure of the facts. In most cases there are no substantial differences in the statements of scientific fact by reputable experts on the two sides, although there may be wide differences in the inferences drawn from these facts. The failure to note a fact, or any distortion or misstatement of a fact, is followed quickly by correction or criticism from the other side, that the professional witness usually takes the utmost pains to make his statement of fact scientific and precise as far as his ability goes. Few scientific treatises in geology contain any more accurate accounts of mineral deposits than testimony in cases of this sort. If every student of geology, early in his career, could have a day on the witness stand on a geologic problem, under both direct and cross-examination, he would learn once and for all the necessity for close and accurate thinking,

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*Abstracted from 'The Economic Aspects of Geology', published by Henry Holt & Co., New York.

the difference between a fact and an inference, and the difference between inductive study of facts and the subjective approach to a problem.

It is a common assumption that a witness called to testify on scientific matters is on a somewhat different basis from the eye-witness to an event or transaction. We are not sure that this assumption is justified. Seldom is it possible in mining operations to disclose the facts in three dimensions so completely that they may be empirically observed and platted by the layman. The grouping and presentation of the facts in adequate perspective require an analysis of the origin of the ores and rocks, the rock alterations, the structural systems, and other facts. No one ever saw the vein or lode in the process of formation. The true nature of the event and of its physical results must be inferred inductively from circumstantial evidence. If it be conceded that it is necessary and right to call an eye-witness to an event involved in litigation, it is equally necessary where there are no eye-witnesses to call the persons best qualified to interpret the circumstantial evidence.

It is to be remembered that apex cases are only one kind of a vast variety of cases affecting mineral resources. At one time or another, and in some connection or another, practically every geologist of considerable experience has found it necessary to testify on geologic matters in court. The wide interest attaching to certain spectacular apex cases has led in some quarters to hasty criticism of the participation of geologists therein, without apparent recognition of the fact that the criticism applies in principle to many other kinds of litigation and to practically all economic geologists. This criticism also fails to take cognizance of the fact that, for every case tried, there are many settled out of court through the advice and co-operation of geologists. While there may be in the geologic profession, as in others, a very few men whose testimony can be bought outright, in general it must be assumed that geologists will appear on the witness stand only when, after careful examination, they are satisfied that there is a legitimate point of view to be presented.

Geologists and engineers understand more clearly than almost any other group the extent to which the complexities of nature vary from the conditions indicated in the simple wording of the law of extra-lateral rights. Almost to a man, they favor either modification or repeal of the law. On the other hand, the law has been in force since 1872, it has been repeatedly interpreted and confirmed by the courts, and a vast body of property rights has been established under it. Lawyers see great legal difficulties in the way of its repeal or serious modification. Mining men for the most part are not primarily interested one way or another, unless there is potential application of the extra-lateral-rights provision to their particular properties. Of those who are thus interested, some hope to gain and some fear they may lose in the application of the law. The general public naturally has little direct interest in the problem. There is thus no effective public sentiment favoring the repeal or modification of the law. It seems likely that for some time to come the law, in spite of its recognized defects, must be applied, and the best geological effort must be directed toward reaching interpretations which come most near to meeting its intent. To refuse to lend geologic science to the aid of justice because the law was improperly framed is hardly a defensible position. Presumably it will never be possible to frame laws with such full knowledge of nature's facts as to eliminate the necessity for scientific advice in their interpretation.

It has been suggested that the courts, and not the litigants, should employ the geologists. The practical objection to this proposition lies in the difficulty encountered by the judge in the proper selection of geologists. On the assumption that the judge would select only men in whom he had confidence, it is not likely that he would override their conclusions. The outcome of the case, therefore, would be largely pre-determined at the moment the selection of experts was made. It is to be doubted whether courts can have the knowledge of the scientific field and of the requirements of the situation necessary to make the wisest selection of men to interpret the given condition. The competitive element would be eliminated. From a judicial standpoint, there seems to be an equally good chance of getting at the best interpretation of the facts by listening to presentations from different standpoints, with the accompanying interplay of criticism and questioning.

Another practical objection to appointment of experts by the court is the limitation of court costs, which would make it impossible to secure the highest grade men. So far as these men are public employees, such as members of the Federal or State geological surveys, this might be arranged. For others, it might be suggested that they should be willing to sacrifice their energy and time in the interests of justice; but as long as human nature and conditions are what they are, it is perhaps futile to argue this question.

If it is right to apply science to practical affairs, in other words, if the profession of economic geology is a legitimate one, it seems inevitable that the application must be in some part directed by the geologist himself, in order to avoid mistakes and confusion. The contention that the scientist must isolate himself in a ratified atmosphere to avoid contamination from a non-scientific, commercial, or legal atmosphere, seems to me practically untenable, if we recognize any obligation on the part of science to the practical conduct of human affairs. The fact that the geologist in making these applications may occasionally find himself in a non-scientific atmosphere may be deplored from the standpoint of maximum creativeness in science, and from this standpoint there may be reason for limitation of time given to this kind of work—but to stay out entirely on this ground is to deny his obligation to make his science helpful to his fellows. The problem cannot be solved by staying out. It calls rather for an especial effort on the part of the scientist to establish and maintain his standards of science and ethics in the applied fields. Some doubtless fail in this effort. Others are strengthened scientifically and ethically, and contribute important aid in raising general standards. The principle of non-participation in such activities for fear of lowering scientific standards may make the geologist's problem easier, but at the expense of non-fulfillment of duties. Such a course has for its logical consequence an abandonment of the application of his science to untrained men without the ethical anchorage of scientific achievement. In short, there may be legitimate criticism of individual geologists for their methods and ethics in the applied field, and this is desirable as an aid to maintaining and improving standards; but it is not a logical step from this to the conclusion that, to avoid unfortunate incidents, economic geologists must cloister themselves and thus deny the very implication of their titles.

Round Mountain District of Nevada

The Paleozoic sediments of the Round Mountain district of Nevada have been intruded by granite of Cretaceous or possibly early Tertiary age, according to H. G. Ferguson, in U. S. Geological Survey Bulletin No. 725-I. This granite represents a phase of the great granodiorite intrusion that is today exposed over a large part of the Toquima range. Closely following this intrusion quartz veins carrying manganese tungstate were formed in the granite. These veins have been exploited to some extent.

In Miocene (probably upper Miocene) time the region was covered by the bedded tuffs, shale, and sandstone of the Siebert formation. After these deposits were laid down there came a large intrusion of rhyolite. This intrusion appears to have reached a level comparatively near the surface. Numerous small fissures were formed in the newly solidified rhyolite, and these were filled with solutions derived from the rhyolite, which gave rise to the primary quartz veins carrying free gold. The primary vein-filling consists of quartz with minor adularia and alunite, free gold considerably alloyed with silver, a small amount of auriferous pyrite, and a little realgar. The alteration of the wall-rock consisted of sericitization of the feldspars, the introduction of some pyrite, and slight silicification near the walls of the veins. The period of ore deposition must have been late Miocene or Pliocene. Other productive ore deposits of Nevada belong to the same general period and appear to be genetically related to intrusives of post-Siebert age.

After a period of erosion, renewed fissuring took place. This fissuring may have been contemporaneous with the Pleistocene faulting, which formed the scarp of the Toyabe range, facing Big Smoky valley on the west. Some of these fissures followed the quartz veins already formed and others crossed them in all directions. Oxidation of the pyrite took place during a period in which the climate was more humid than the present and the water-level not so greatly depressed. The surface-waters followed the newly formed fissures, and iron and manganese oxides, together with gold derived from the auriferous pyrite, were deposited along these channels, which in many places were distinct from the quartz veins. It is not certain to what extent solution of the free gold of the primary veins contributed to the formation of the secondary fissure filling.

The placer deposits were formed under conditions of climate and topography similar to those of the present. In the Sunnyside placers, angular rhyolitic talus carries most of the gold. This talus is overlain by roughly stratified fanglomerate, the result of successive floods rather than steady stream deposition. The fanglomerate forms nearly the whole of the Red Jacket ground.

THE British consul at Nouméa reports that as there is no market for nickel at present, most of the nickel mines in New Caledonia have been closed down or their production reduced, states the 'Board of Trade Journal'. The Société le Nickel, of Paris, and the Société des Hauts Fourneaux de Nouméa are still operating their mines, and a little work is being done at the Maconnaise and Gracieuse mines at Dumbéa, near Nouméa. The two first-named companies own large areas of undeveloped mining land and also nickel-smelting works. A large hydro-electric plant with a capacity of 30,000 hp. is being erected at Yate for the Société le Nickel, and a nickel-smelting plant, erected at Nouméa by a Japanese company, has not yet begun operations. Exports of ore and matte from New Caledonia have been in metric tons as follows:

	Ore	Matte
1913	93,194	5,893
1914	94,154	5,287
1915	48,576	5,529
1916	30,679	4,935
1917	32,018	6,319
1918	15,612	3,938
1919	1,561	3,813
1920	3,246	4,508

The decreased export of ore is due to the development of local smelting plants, which will soon absorb the entire production. In recent years France has taken almost all the ore, and the United States most of the matte.

THE domestic shipments of high-grade manganese ore, containing 35% or more metallic manganese, amounted to about 13,000 gross tons in 1921, of which more than 10,000 tons was shipped from Montana, according to H. A. C. Jenison, of the U. S. Geological Survey. The shipments of ore containing 10 to 35% of manganese amounted to about 72,000 tons, most of which was shipped from Minnesota. The shipments of manganiferous and ferruginous manganese ore amounted to about 14,000 tons. The net imports for the first eleven months of the year amounted to 386,405 tons of high-grade ore and oxide, valued at $3,288,595. Of this Brazil contributed 247,568 tons, valued at $7.58 per ton, and India 113,730 tons, valued at $6.46 per ton. The most important event that may affect the future of the domestic industry was a favorable report by the House of Representatives on a proposed tariff on imports of manganese ore of 1 cent per pound of metallic manganese content of ore or of concentrate containing more than 30% of metallic manganese.

REVIEW OF MINING

GREENE-CANANEA COPPER CO. WILL RESUME PRODUCTION AS SOON AS RE-VAMPING OR REDUCTION WORKS IS COMPLETED

Although no definite date can be set, the Greene-Cananea Copper Co. will probably begin production by early summer. Extensive alterations are under way at the company's mill and smelter, adding over 500 tons per day to capacity of the reduction works.

The company has approximately 700 men on its payroll, and while a large proportion of these are employed on alteration work, a number are getting the property ready for the production of ore. There have been decided changes in the labor situation in Mexico from the standpoint of both wage-scale and efficiency. At the height of the war boom the Mexican peon was getting $4 per day gold, or eight pesos. The present scale for labor in the mining districts is from three to four pesos daily, or from $1.50 to $2 gold. In the mining district surrounding Cananea in Sonora, there has been a conspicuous absence of political strife since the inauguration of the Obregon regime. In normal times Greene-Cananea can produce upward of 53,000,000 lb. of copper per year, and with its new and enlarged reduction works this amount can be increased, with a consequent reduction in costs.

UTAH CONSOLIDATED CO. APPEALS UTAH-APEX DECISION TO HIGHER COURT

What virtually amounts to the last step in the litigation between the Utah-Apex Mining Co. and the Utah Consolidated Mining Co. has been taken. Utah Consolidated has been granted a motion for a rehearing of the case before the Court of Appeals by Judge Grant of the U. S. District Court who has fixed a bond of $1,300,000. On February 1 Utah Consolidated filed this bond and preparations are being made for argument before the Court. After the hearing of suits by Utah Consolidated and counter suits by Utah-Apex, a verdict was awarded the latter company and Utah Consolidated was ordered finally to pay the Utah-Apex Mining Co. approximately $1,200,000 for illegal extraction of ore. It is this award that is being contested.

CARSON HILL COMPANY PURCHASES MELONES GROUP

W. J. Loring, president and general manager for the Carson Hill Gold Mines Co., announces the purchase by his company, for a cash consideration of $450,000, of the Melones group of mines that adjoin the Carson Hill property in Calaveras county. The Carson Hill company acquires all of the property of the Melones company except the hydro-electric power-plant; this includes a 100-stamp mill that was built in 1901 but that has been idle since 1918. Some years ago Mr. Loring, in behalf of the Carson Hill company, purchased the adjoining Morgan group for $600,000. In the course of development he found that the lode branched at the 1450-ft. level, one leg going toward the Melones ground. In 1920 Mr. Loring obtained an option on the Melones group and commenced development by cross-cutting from a winze that the Melones company had sunk below the 3000-ft. level. Good ore was found in the hanging-wall cross-cut, and as a result the winze was sunk farther to the 4000-ft. point. Four levels were opened between 3500 and 4000 ft., but the richest ore was found on the bottom level. Thus far a shoot 230 ft. long and 16 ft. wide, which will average about $20 per ton, has been developed. For the present the ore will be treated in the 30-stamp mill of the Carson Hill company. The recent purchase gives the Carson Hill some 1000 acres of ground, including 10,200 ft. of outcrop along the Mother Lode.

Carson Hill Mine and Mill, at Melones, California

DEVELOPMENT OF WATER-POWER FOR MINING IN ALASKA

The Federal Power Commission has issued the following permits and licenses for the development of water-power in Alaska: To the Alaska Development & Mineral Co.; power development on the Tyee and Anan creeks, and an 18-mile transmission-line with two dams, 60 and 100 ft. high and a 9000-ft. tunnel, to produce 14,000 hp. To the Hirst Chichagof Mining Co.; on a tributary of Didrickson bay, Chichagof island, to develop 400 hp. for use in connection with development of mining properties. To the Alaska Endicott Mining Co.; to develop 300 hp. on lands of the U. S. in the Juneau district for use in mining. To J. H. Cann of Juneau, Alaska, for a project on Chichagof island of 60 hp. for the development of mining claims.

INSPIRATION COPPER COMPANY IS EMPLOYING ADDITIONAL MEN

Although no definite date has yet been set for the resumption of production by Inspiration Consolidated Copper Co. at its mines at Miami, Arizona, men are being steadily added to the payroll. There are increasing signs of activity, and efforts are being made to expand its complement of workers to the point where the company can begin the production of ore the moment the starting word is given. With the Miami company's mine and mill in operation and Arizona Commercial, Old Dominion, United Verde Extension, and other companies in the general vicinity preparing for early production, Inspiration is finding it advisable to protect itself with an adequate labor supply.

Unlike the deep vein mines, Inspiration is not faced with all of the problems that attend the resumption of mining at those properties. Its surface equipment has been kept in a high state of preservation and with a sustained supply of ore going through the reduction works, it would not take long for a substantial output of copper to be under way. Inspiration can comfortably produce 120,000,000 lb. of copper per year at a cost as low as any of the leading porphyry copper mines in this country. Of course, capacity production will not be had for many months.

ARIZONA

Bisbee.—Already general business betterment has been noted in Bisbee and Douglas, due mainly to the resumption of smelting at the latter point, where the Copper Queen is operating several blast-furnaces and the Calumet & Arizona two reverberatories. Former employees are coming in, generally from southern California. There is an oversupply of unskilled labor, and scores of Mexicans are crossing the line in hope of employment. Wages are the same as paid last spring, before the shut-down.

In the local mines, the Copper Queen company has turned a number of its men from development to stoping, and silicious ore taken from Sacramento hill is being steam-shoveled into cars, to be used as flux at Douglas; the Calumet & Arizona company is putting on miners. Neither has any present need for ore at Douglas and it is improbable that regular shipments will be resumed before the end of the month. The Boras and Night Hawk lessees are ready to ship when their ore will be received.

An option has been given by the Copper Queen Extension Mining Co. on its Bisbee West property to T. A. Hughes, Jack McGregor, and others. The vendors include James Letson, D. F. McGregry, Mrs. Julia Cunningham, and H. H. Cristy of Los Angeles, Ned Creighton of Phoenix, Harry Jennings, J. J. Flanagan, and M. F. Ryan of Bisbee, and the Higgins estate. The ground, including 22 claims, lies west of the Copper Queen and south of the Shattuck and Higgins properties. Development was started over 20 years ago by a Los Angeles company that sunk two shafts, 400 and 700 ft. deep.——The Centurion mine at Dragoon has been sold to a company that is planning installation of a 75-ton smelting plant of a new design.

Oatman.—The Oatman United has developed, by drilling, over 36 ft. of vein matter, averaging $15 gold per ton. One drill also went through 70 ft. of quartz and rhyolite that averaged more than $5. The vein has been outlined for 800 ft.——High-grade ore is being taken to the Tom Reed mill from the 700-ft. level of the United American, where the new stope is said to be showing well. Bonanzo ore is being mixed with lower-grade material, to bring it down to the $40 maximum received at the mill.——Ore from the Stoney-Ferra lease on Tom Reed ground is so rich that it has been stored for safety in the bullion vaults of the Tom Reed mill. Thus far nearly a ton of such ore has been stored and several hundred pounds of ore valued at over $10 per pound is being mined daily. It is found in a streak about four inches wide. The lease block runs to the depth of only 200 ft. From the Ollie Oatman air-shaft the lessees are drifting toward the vein and will cut it within a few feet more.

A 100-ton mill is to be in operation by April 1, next, on the Highland property, in Tood basin. There is to be flotation equipment to treat the mixed ore of gold, silver, copper, zinc, and lead. The company's main mine is the Golconda, which has an inclined shaft 1400 ft. deep, which produced well a few years ago.

Willcox.—A road has been opened to the property of Galiuro Mining Co., which is reported to have ordered a large amount of surface equipment. The mine is 50 miles from here.

CALIFORNIA

Angels Camp.—A rich body of gold-bearing gravel has been opened at the Victor mine. The material is 'cemented' and will require crushing. Plans have been made for the installation of the necessary equipment. The Victor property includes the old McElroy. Joe Montreeville is superintendent.

Nevada City.—The Penn-California Mining Co. has extended its main adit 2700 ft., and the face of the drift is now in gravel. The tunnel is driven at an elevation low enough to make certain of undercutting the main channel, thereby avoiding the necessity of hoisting gold-bearing material. The property is owned by Pittsburgh capitalists, and A. W. Hoge is manager.

Redding.—The aerial tram extending from the Hornet mine of the Mountain Copper company to Mathewson, a station on the Southern Pacific railroad, has been placed in operation. It is a little over two miles in length, has a daily capacity of 2400 tons, and replaces the old Iron Mountain railroad, used principally by the company for ore-shipments for many years. The company is shipping 500 tons of pyritic ore daily to chemical plants near San Francisco, and with the tram-line in operation is in a position materially to augment its output. A large tonnage of this character of ore has been developed in the Hornet mine and is in demand for conversion into chemicals and fertilizers.

San Francisco.—Clarence E. Jarvis, member of the California State Board of Control, Albert Burch, consulting engineer, Elmer E. Paxton, general manager for the Engels Copper Mining Co., Newton Cleveland, dredge operator of Marysville, and Robert I. Kerr, secretary-treasurer for the California Metal and Mineral Producers Association, have been appointed on a committee to advise the American Mining Congress regarding the methods of mine taxation in the State of California. The purpose of the American Mining Congress is to obtain a uniform system of mine taxation throughout the various States of the nation.

Sonora.—Thomas G. Winwood and Lester Wiseman, both from California, have obtained a 3-year lease on the Spring Gulch mine and the Hidden Treasure property. It is stipulated that work shall begin in 90 days.

IDAHO

Bonners Ferry.—The Eileen Mining Co. will soon be ready to ship silver-lead ore from the property at Eileen, north of here. Earl L. Palmer is manager.

Coeur d'Alene.—The Bunker Hill & Sullivan company has entered a new vein system known as the Jersey, on the level 1600 ft. below the Kellogg tunnel, according to reports. This indicates that the great Bunker Hill orebody will be found in all its richness when reached by the cross-cut on the 1600-ft. level.——Processes that, in connection with an electrolytic-zinc plant to be built by the Bunker Hill company at its Kellogg plant, will effect recoveries 12% higher than those obtained under present treatment methods for Coeur d'Alene ores are described by Wallace G. Wolf, metallurgist for the Bunker Hill company. Experiments with the new method, developed after several years of experimentation, show recoveries from Star ares of 92% of the zinc, 95% of the lead, and 90% of the silver. F. W. Bradley, president of the Bunker Hill, promises that the electrolytic-zinc plant will be built at Kellogg in time to handle the Star ores when that body is reached by the tunnel from the Hecla within two years. He said that the ores of the Star alone would justify the building of the plant. It was estimated that a plant with a capacity for 50 tons of product daily would be needed, to cost between $750,000 and $1,000,000.

More than $7000 was the smelter return from a recent carload of concentrate sent to the Bunker Hill smelter by the Sunshine Mining Co., which has taken over the Yankee Boy mine on Big creek.——Two cars of ore have been shipped from You Like mine, near Mullan, by the lessees.——Officers of the Idaho-Northern Mining Co. were elected at the recent annual meeting. The property is in the Summit disrtict. John A. Sangren is president. Other directors are O. M. Nordquist, vice-president and manager; Walter Keister, secretary-treasurer; O. F. Nordquist, Fred Williams, and Andrew Engquist.

The orebody opened on the main tunnel level of the Western Union mine is reported to be nine feet wide; the ore can be sent to the smelter.

MICHIGAN

Houghton.—No great increase in the production of refined copper may be looked for from the Lake district for several months after operations are resumed about April 1 by Calumet & Hecla and three of its subsidiaries, Ahmeek, Allouez, and Isle Royale. The present metal output of this district is between 8,000,000 and 9,000,000 lb. per month. With the resumption of the Calumet & Hecla properties this total, it is estimated, will be increased only to between 11,000,000 and 12,000,000 lb., and this rate no doubt will maintain for some time. Two factors will determine the extent of further increase in production. These are labor and metal demand.

Since the shut-down of the mines on April 1 last year, Calumet & Hecla has continued to operate its smelting plant, smelting such mineral and mass copper and cupola-blocks as had accumulated at the plant. From 6 to 12 furnaces out of a total of 21 have been in blast and the electrolytic plant also has been in continual operation, the cathods from which have been re-smelted. An average of better than 2,000,000 lb. per month of refined copper has been turned out. The smelter has only enough material on hand to keep it operating until a new supply comes from the mills upon the resumption of mining.

Ahmeek produced 20,000,000 lb. of metal in 1920. This property, it is expected, will nearly approach that rate of output soon after the resumption of operations. Isle Royale produced 10,000,000 lb. in 1920 and Allouez at the rate of 5,000,000 lb. Mohawk and Wolverine are at capacity production, and it is not expected that the Copper Range and Quincy will increase their present respective outputs for some months to come.

Both Champion and Trimountain of the Copper Range company showed a small increase in rock-production in January, while Baltic maintained the rate which obtained in December. Champion is now sending 2500 tons of rock daily to the mill, increasing from a total of 62,000 to 65,000 tons for the month, and Trimountain increased from 13,000 to 14,000 for the month. Baltic sent 16,000 tons to the mill. All drifts and stopes continue to yield ore fully up to the average for these mines. Champion made a net gain of about 30 men in January, the other mines holding their own in the usual labor turn-over.

Work is proceeding in six Calumet & Hecla shafts, preparing them for resumption of mining. Three shifts of men are employed in the Red Jacket shaft, two shifts in No. 2 and 4 in the Calumet branch, and two shifts in No. 6, 7, and 8 in the Hecla branch. The ground is badly caved in the lower levels and the re-opening of the shafts is a large task. Much slate and vein matter are being taken out and some of this rock will be available for milling. Minor repairs are under way in the Calumet mill, but no attempt is being made to put the reclamation plant in condition.

Isle Royale probably will not operate more than two shafts when mining is resumed. The work of replacing the concrete skipway in No. 5 shaft with timber is well under way, and this shaft no doubt will be ready by April 1. No. 5 and 6 shafts are well opened.

Mayflower has stopped work in the north drift in about 200 ft. on the 1450-ft. level and a south drift has been started. The north drift has opened ground fairly well mineralized, but it is quite 'trappy' in spots. There is no indication of faulting, however, and this is regarded as favorable. There is no change in the cross-cut at the 1700-ft. level, which is still in trap.

MISSOURI

Carterville.—A remarkable deposit of lead ore has been drilled at the old Ten O'Clock mine west of Prosperity by S. D. Eurit, who is manager for a company composed of himself, J. R. Eurit, and Alfred Vick. Three holes have been sunk, all of which have shown good ore, the first at 27 ft., the second at 40 ft., and the third at only 12 ft. The last of the three holes was drilled to a depth of 70 ft. and the deposit of rich lead which was struck at 12 ft. was still good at 70 ft. The first drill-hole, showing lead at 27 ft., was continued to 95 ft. with the lead still showing while the second began at 40 ft. and continued to a depth of 105 feet.

MONTANA

Elkhorn.—Higher costs and a lower gold yield than expected were encountered when mining was resumed at the gold mine of the East Butte company. Both these difficulties have been taken in hand and the mine is now returning a profit. In December this property barely made a new dollar for an old. January, however, showed a balance on the right side of the ledger. The mill is now treating about 100 tons of ore daily.

Laurel.—It is reported that officers of the Glengary Mining Co. have decided to erect a smelting-plant here for the treatment of ore from Cooke City. P. F. Daly, Sam C. Rice, and Francis A. Hancock of Miles City and Ray Bishop of Cooke City are interested in the project. The Glengary company has a group of claims north of Cooke City, on which some ore is said to have been blocked out.

NEVADA

Battle Mountain.—Placer mining at the Homestake property, in Copper canyon, is proceeding steadily despite the cold weather. The management reports that the ground is yielding a satisfactory return in gold and that sufficient water is available for a long season.——Construction of a mill at the Betty O'Neal mine has been decided on by the directors. The plant is to be provided with concentration and flotation equipment and is to have an initial capacity of 100 tons. The ore is silver.

Luning.—At the Luning Consolidated mine, six miles from here, two classes of ore are being shipped. One is a silver-gold ore that is going to the mill of the Tonopah Mining Co. at Millers, and the other is an ore containing an iron oxide that is being used for the manufacture of paint. This is being shipped to the company's plant at Richmond, California.

Manhattan.—With the approach of warm weather the White Caps company, operating a mine and mill at Manhattan, is preparing for more comprehensive work. The winze from the 800-ft. level is going down on the foot-wall of the main vein, and when it reaches a depth of 150 ft. lateral work will be started on the orebody. Arrangements are being made for early resumption of production.

Unionville.—Stope-filling in the old Arizona mine is being measured and sampled. A considerable tonnage is being removed and sorted, and from each 20 tons it is declared that there is one ton of high-grade found. A streak of high-grade ore that was left in the early days also is being followed. Exhaustive tests in the milling of the stope-filling are also being carried on.

Virginia City.—The Middlemines company has completed the re-timbering of the Hale & Norcross tunnel and has placed the track for the mine-cars in the lateral. Pipe for compressed air is being installed, and soon drifts will be started from the tunnel to prospect the upper levels of the Best & Belcher, Gould & Curry, Chollar Potosi, and other mines composing the group.——An exceptionally severe winter is hampering surface operations at many properties near Gold Hill and Silver City, and in several instances work has been completely halted. At many points the snow is three to four feet deep. However, the bad weather is believed to be nearly at an end.

UTAH

Alta.—On the night of February 4-5, about twenty-five snowslides occurred in this district. The canyon road was completely blocked, and the only way to enter or leave the district was by means of snowshoes. Ore shipments consequently were suspended by the mining companies. The boarding-house of the South Hecla Mines Co. was damaged to the extent of $500; power-lines of the Utah Power & Light Co. were torn down in a number of places; ore-bins of the Emma Silver Mining Co. were destroyed; the tramway of the Michigan-Utah company was put out of operation; and the snowsheds at the Columbus-Rexall tunnel and the Quincy tunnel were carried away. Fortunately, there was no loss of life.

The boarding-house of the Michigan-Utah Mining Co. was completely destroyed by fire on February 7. The loss is $12,000, with insurance of $6500. The company has been employing 30 men, who lost all of their personal effects. The men will room and board at the Alta Consolidated boarding-house until a new structure can be built at the Michigan-Utah.

At a meeting of the stockholders of the Sells Mining Co., on February 7, it was voted to accept the proposition of selling the company's entire holdings to the South Hecla Mines Co., on the basis of four shares of Sells stock for one share of the Hecla. Announcement has been made by George H. Watson, president of the South Hecla, that his company has also acquired the Native Copper group of the K. P. Mining Co. in the Alta district.

Development of the new orebody in the Columbus Rexall mine is satisfactory. An average sample from the face of the south-east drift assayed 24 oz. silver and 69% lead, according to C. M. Evans, superintendent. Shipments have been made from the orebody cut in the 757 drift from the No. 8 level. The last three carloads shipped netted the company, after freight and smelter charges, $6450.

Bingham.—While no definite announcement has been made as to when the Utah-Apex mine will re-open, the equipment in the mine has been overhauled and improved. The company did not operate at all in 1921, due to the depression in the lead market. During the fiscal year ended August 31, 1921, gross receipts from ore sales were $358,723, while expenses totaled $542,436, leaving a deficit of $183,713.

Eureka.—Representatives of the Knight Investment Co. have been sampling what is known as the Carisa and Spy sections of the Empire Mines Co.'s property. These sections have been highly productive in by-gone days, and development work there will be watched with interest. A power-line, 5800 ft. long, has been built from the Chief Consolidated mine to the Grand Central property. As soon as the compressor is installed at the Grand Central, all machinery will be electrically-driven and the old steam equipment will be abandoned.

In an effort to close up the affairs of the Eagle & Blue Bell Mining Co., which has been taken over by the Bingham Mines Co., an appraisement of the company's mine was recently made by G. W. Crane, geologist, J. E. Bergh, mining engineer, and Theodore P. Holt, metallurgist. The total valuation of the mine, according to report sent stockholders of the Eagle & Blue Bell, is $3,135,005, or about $1.80 per share.

Ore shipments for the week ending February 4 totaled 156 cars, as compared with 145 cars for the preceding week. The Tintic Standard shipped 63 cars; Chief Consolidated, 41; Iron Blossom, 12; Grand Central, 8; Victoria, 8; Centennial-Eureka, 4; Colorado, 3; Alaska, 2; Bullion-Beck, 1; Eureka Hill, 1; Gemini, 1; Tintic Drain Tunnel, 1.

Marysvale.—George H. Hemphill, manager of the American Consolidated Mines Co., which controlls the I. X. L. property in the Mt. Baldy district, states that 400 sacks of ore have been shipped. While picked samples of the sulphide ore assays $20 gold, 491 oz. silver, and 35% lead, and carbonate samples as high as 139 oz. silver and 39% lead, Mr. Hemphill believes that the average for the lot will be from 60 to 100 oz. silver.

Development is to be undertaken by the Valdasia Mining Co., according to Patrick F. Henry, president. The company owns about 400 acres of ground, most of which is patented. The deepest shaft is down 450 ft. Gold-silver ore has been exposed in four places. The property is about two miles from the Deer Trail mine. Officials of the company believe that the principal Deer Trail vein crosses the Valdasia property for a distance of nearly a mile. A tunnel is to be driven to overcome the necessity for pumping.

Park City.—Ore shipments for the week ending February 4 totaled 2158 tons, of which the Judge allied companies produced 1003 tons; Silver King Coalition, 661; and Ontario, 494. Shipments the previous week totaled 2024 tons.

WASHINGTON

Valley.—Following the completion of the first two units of a $100,000 magnesite finishing-plant, by April 1, the American Mineral Products Co. will begin active operation, according to H. L. Grizzell, superintendent. The Valley concern is engaged in the quarrying and manufacturing of plastic for stucco, flooring, and other products. "We have been working for three years to perfect the new process for the manufacture of plastic magnesite," says Grizzell. "Last year we drafted the plans for a $100,000 plant, which will be complete in every particular. The first two units, costing $25,000 each, will be finished by April 1, and we will start up with one unit, probably with a force of 60 men in the new plant."

WISCONSIN

Platteville.—Acting upon the solicitation of zinc-mine operators, the Wisconsin School of Mines, at Platteville, enlisted the U. S. Bureau of Mines in an effort to determine some method whereby the loss of fine zinc and lead mineral in the concentrators of this district could be overcome. W. H. Coghill and C. O. Anderson, of the staff of the Mississippi Valley station of the Bureau of Mines, were assigned to the task about a year ago. They first investigated the process of wet concentration in general practice in the district, to ascertain the condition of the minerals lost, the proportion, and the reason for these losses.

The recovery of zinc and lead in the jig used is about 70%, which is regarded as a good recovery for jig concentration. Consistent and frequent trials have been made by zinc-operators in the use of various tables to save the fine at wet mills, but the presence of marcasite made it impossible to obtain a clean zinc product. The Overstrom table manufactured by the Allis-Chalmers Co., of Milwaukee, was the first to be so used. It was followed by the Wilfley, Deister, Card, and other tables, but all without success. After the preliminary study, Coghill and Anderson discovered that about 65% of the valuable mineral lost at the mills occurs in material which is finer than 20-mesh (0.0340 in.); and that this represents only about 25% of the gross amount of tailing. They devised a plan for screening the tailing to this size and then treating this tailing on concentrating tables to produce a low-grade zinc-lead-pyrite concentrate. This concentrate was treated by on oil-flotation process that makes it possible to separate the various minerals.

The equipment required to carry out the operation is comparatively inexpensive, and the cost of operation is sufficiently low to enable a fair profit to be realized from the concentrate recovered. It is estimated that half a million dollars annually will be saved by the process.

BRITISH COLUMBIA

Greenwood.—P. J. Crane and Duncan McIntosh have run into an ore-shoot, assaying up to 6000 oz. per ton in silver, at the Bell mine, at Beaverdell. The Belll has been shipping a good grade of ore for some time, but nothing approaching the present find.

Nelson.—The Nelson Copper Fields, Ltd., reports opening new ore carrying native copper, gold, and silver in the No. 1 vein at its Birdseye property, on Morning mountain.——O. C. Thompson, one of the lessees of the Utica mine, in the Slocan, reports entering soft ground in the No. 1 tunnel, which is thought may be the extension of the vein that is the tunnel's objective. The soft ground will be followed in a direction to undermine the ore-shoot, and when that point is reached if the shoot is not found cross-cuts will be started in both directions. In the meantime good ore is being found in the upper workings; the last shipment of 40 tons having given a return of 159 oz. of silver per ton, 14.6% lead and 24.6% zinc.——The annual report of the Cork-Province Mines, Ltd., for the year ended June 30, 1921, shows liabilities in unpaid bills amounting to $38,732, and assets in stores, mine, and plant amounting to $606,738. The directors have advanced money to pay the taxes and the more pressing bills, and it has been decided to raise money for the development of the mine and for additional power-plant, in order that the mine may be operated throughout the year. Recently work has been resumed at the mine, after 18 months of idleness.——During the winter a 209-ft. raise has been put up at the California mine, connecting the No. 3 and No. 2 levels. The Athabasca mill, which the California Mining Co. acquired, has been remodeled, and milling operations will soon be started. Experiments have demonstrated that after a light roasting more than 95% of the gold content can be recovered from the concentrate by cyaniding. The gravity concentrate runs about $40 in gold and the flotation concentrate $70.

Prince Rupert.—The tunnel at the Lion group, near Alice Arm, has cut the orebody, which shows a number of rich stringers, carrying native silver. A drift has been started on the foot-wall of the vein, with a view to developing the shoot that assayed 660 oz. silver per ton on the surface.——The Tridway Mines, Ltd., has been organized to take over and operate the Fiddler Creek Gold Mining Co.'s property.

Quesnel.—New York interests have bonded the Lynes and Pratt claims at Cedar creek, where rich placer ground was discovered last fall. Supplies are arriving at Quesnel Dam, where a camp will be established.

Rossland.—Word has been received from Ottawa that the Federal Railway Commission has decided that it is not within its power to prevent the Great Northern Railway from abandoning its Red Mountain branch, running from here to the international boundary. John Oliver, Premier of British Columbia, has announced that he will introduce a bill at the next session of the Provincial Legislature to provide that the right-of-way of a railway company that ceases to operate the line shall revert to the Crown.——The Le Roi No. 2 mine has suspended operations temporarily, on account of the snow and ice covering the dumps. Since it re-started operations last spring the company has confined itself to the picking over of old dumps, and concentrating the ore by flotation.

Trail.—The ore receipts at the smelter for the last ten days of January totaled 10,676 tons. The Le Roi No. 2 shipped 120 tons of concentrate; the Metallic group, Silverton, 24 tons of ore; the Molly Hughes, New Denver, 29; and the Utica, Adamant, 34. The rest came from the Consolidated company's own mines.

Victoria.—R. C. McLeod, of Vancouver, is organizing a company to take over and operate the Three W's group, at the head of Franklin creek, nine miles from Port Alberni, Vancouver Island. When the Ladysmith smelter was in operation several consignments of ore were sent from this property to the smelter, the value of the shipments ranging from $200 to $300 per ton, principally in gold.

MEXICO

Chihuahua.—Antonio Perez has recently discovered some silver-gold veins in the Viga mountains near San Francisco del Borja mining camp. He has filed on two claims which are being surveyed by A. B. White.——Herminio Fernandez of Jimenez has applied for titles to La Constancia group of six claims in the Cebollin mountains, near Villa Lopez. He has discovered some high-grade silver-lead ores containing some gold.——The Luis and Romulo mines, of the Batopilas district in the south-western part of the State, are being developed by Jose Maria Diaz. These properties are traversed by some strong veins carrying gold, silver, and lead. A main shaft is being sunk on the principal vein.

El Oro.—The new railroad reaching the mines of the Mexican Mines of El Oro company has been completed and will shortly be in operation. This line extends from La Coma station on the National Lines of Mexico to Monte de San Pedro. With the completion of the road the mines of El Oro company will be operated on a larger scale; it now has better facilities for shipping its ore and bullion, and receiving general supplies and machinery.——Work is again resumed in La Aurora mine of El Oro district, where approximately 100 miners are employed. Operations were temporarily suspended recently.

Mexico City.—According to a report from the Secretary of Finance 36,000 gold coins known as 'centenarios', with a value of ₱50 each, were coined in the Mexican mint during the month of January. Only a small amount of silver and other moneys of small denomination were minted.

Torreon.—Robert F. Fitz of Los Angeles arrived here this week to look after his mining interests in the Penon Blanco and other districts near here.——W. E. Friedrich, who has recently taken the management of the Trinidad mines in the Chalchihuites district, State of Zacatecas, left here this week for that place. Shipments of ore are now being made to the A. S. & R. smelter at Asarco.——Herbert Stanton, formerly manager for the Cia. Minera La Trinidad, passed through this week from Zacatecas en route to Chihuahua, where he will take charge of mining properties.——J. P. Steele, owner of La Trovador mine in the San Diego district of Durango, is making regular shipments to the Torreon smelter.

ONTARIO

Cobalt.—Operations at the Kerr Lake have been completely suspended, as the result of development work has not been satisfactory and operating costs have not declined in proportion to the decrease in the price of silver.

The gross earnings of the Bailey customs mill during January were approximately $13,370 from the treatment of 4456 tons of ore. The Bailey mine shipped 706 tons of ore to the mill from the Silver Cliff mine.

Gowganda.—The deal whereby the Trethewey makes over its assets to a new company, the Castle-Trethewey Mines, Ltd., for 400,000 shares in the new company, has been completed and 1,600,000 of the new stock is being offered to shareholders at 10c. per share.

Kirkland Lake.—At the Ontario Kirkland the vein which has for some time been under development on the 300- and 450-ft. levels has been cut at the 150-ft. level, where it is six feet wide.——The vein on the Queen Lebel at a depth of 18 ft. has widened to the full width of the shaft.——All the Kirkland Lake mines, with the exception of the Kirkland Lake, which reduced wages several months ago, have posted notices of a cut in wages of 50c. per day, effective on March 1.

Porcupine.—It is reported that in a seven-day continuous run at the Dome Mines a recovery of gold approximating $200,000 was obtained. It is understood that owing to the increased richness of the ore, tanks and additional cyanide equipment will shortly be installed.

The Hollinger Consolidated has ordered new machinery for the enlargement of the mill. Extensive plans are being carried out in underground development to provide increased hoisting facilities to enable the supply of ore for the mill to be increased to between 6000 and 7000 tons per day.

The Porcupine Vipond-North Thompson has applied to the Northern Canada Power Co. for a supply of power and has been given assurance that the requirements of the mine will be met by April 1. The workings will be unwatered and the main shaft on the North Thompson section continued from its present depth of 600 feet to 900 feet.

South Lorrain.—The stockholders and bondholders of the Maidens Mine have decided to increase the capital from $1,000,000 to $2,000,000. The bondholders have agreed to take stock in settlement of their claims, and a limited number of shares will be sold to raise funds for an examination of the property.

West Shining Tree.—The Ribble Mines, Ltd., has been organized with a capital of $2,000,000 to develop the Ribble vein. It will absorb the Wasapika Consolidated by exchanging five Wasapika shares for one of the new company. If all the outstanding Wasapika shares are exchanged it will require 891,516 shares of the new stock, leaving 1,108,484 shares available for sale to raise funds for development.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Frank D. Pagliuchi is in Cuba.

F. W. Bradley has returned from Spokane.

F. D. Adams, of Oakland, is at Yucca, Arizona.

Richard M. Geppert, of Minneapolis, is in London.

A. C. Beatty has been in East Africa, and is now in Ceylon.

William R. Wright has sailed from England for Mexico.

C. E. Meissner has returned to New York from Mexico City.

L. J. Ingolfsrud is with the Mond Nickel Co., at Coniston, Ontario.

W. E. Sands has moved from Randsburg, California, to McGill, Nevada.

R. C. Gemmell spent a few days in San Francisco and Los Angeles recently.

Robert A. Kinzie has returned to San Francisco from Mazatlan, Mexico.

H. B. Tooker, traffic manager for the Jackling copper companies, is in New York.

G. H. Russell, manager for the Northern Light Mining Co. of Council, Alaska, is at Yuma, Arizona.

W. J. Woolsey is erecting a mill for the Pacific Asbestos Corporation at Copperopolis, California.

Edward Wilcoxson, metallurgist and assayer, has moved from Pueblo, Colorado, to San Luis Obispo, California.

W. J. Loring has gone to Boston, New York, and Washington, expecting to return to San Francisco in six weeks.

Ralph S. G. Stokes, assistant manager for the De Beers Consolidated, has returned to Kimberley after a visit in England.

Joseph Clark, metallurgist, of St. Louis, Missouri, is at La Libertad, Chontales, Nicaragua, with the Chontales Mines Company.

John M. Fox has resigned as superintendent of the California Rand Silver, Inc., and is now at Johannesburg on professional business.

Byron N. Egan, of Eureka, Utah, has accepted a position with the Braden Copper Co. He sailed from New York on February 11 for Valparaiso.

David J. Cooke, of Salt Lake City, has accepted the position of general superintendent of the Consolidated Mascot Mines Corporation near Hailey, Idaho.

E. J. Donohue has resigned the management of the Britannia mine, and will take a holiday, to recuperate from illness caused by the recent disaster at the mine.

Walter J. Akert, who has been employed with the Union Assay Office and R. H. Officer & Co. of Salt Lake City for several years past, has accepted a position as chemist with the Chino Copper Co. at Hurley, New Mexico.

OBITUARY

George R. Comings, U. S. Assayer at the Assay Office in New York City, died on January 17. He was born in Connecticut in 1860, educated in New York, and graduated from Cooper Union. He entered the Assay Office at 13 years of age, working under Dr. Torrey, the first assayer, whose son he succeeded in 1910. He leaves a widow and one daughter.

John J. Ambrose, age 22, died on February 6 at Eureka, Utah, as a result of injuries sustained in a fall of 50 ft. down a stope in the Tintic Standard mine. He was a graduate of the University of Wisconsin, and had only worked six shifts when the accident occurred. For some time past he had been employed as a chemist in one of the Utah County sugar factories.

THE METAL MARKET

METAL PRICES

San Francisco, February 14

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	14.25—14.75
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$90
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.50—7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

February 13.—Copper is dull and lower. Lead is quiet and steady. Zinic is inactive but firm.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Feb. 7	65.62½	34.37½
" 8	65.62½	34.12½
" 9	65.87½	34.12½
" 10	65.75	34.12½
" 11	65.87½	34.37½
" 12 Sunday		
" 13 Holiday		

Average week ending	Cents	Pence
Jan. 2	64.82	34.90
" 9	64.90	34.83
" 16	66.06	35.31
" 23	65.27	34.90
" 30	65.46	35.06
Feb. 6	66.35	35.00
" 13	65.75	34.22

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	132.77	65.95	65.45	July	92.04	59.99	....
Feb.	131.27	59.55	....	Aug.	96.23	61.59	....
Mch.	125.70	56.08	....	Sept.	93.66	66.22	....
Apr.	119.56	59.33	....	Oct.	83.48	71.00	....
May	102.69	59.90	....	Nov.	77.73	68.24	....
June	90.84	58.51	....	Dec.	64.78	65.76	....

COPPER

Prices of electrolytic, in cents per pound.

Date	
Feb. 7	13.25
" 8	13.25
" 9	13.12½
" 10	13.12½
" 11	13.12½
" 12 Sunday	
" 13 Holiday	

Average week ending	
Jan. 2	13.62
" 9	13.56
" 16	13.62
" 23	13.54
" 30	13.48
Feb. 6	13.29
" 13	13.17

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	19.25	12.94	13.54	July	19.00	12.46	....
Feb.	19.05	12.84	....	Aug.	19.00	11.71	....
Mch.	18.49	12.20	....	Sept.	18.75	12.03	....
Apr.	19.23	12.50	....	Oct.	16.53	12.66	....
May	19.05	12.74	....	Nov.	14.63	13.07	....
June	19.00	12.83	....	Dec.	13.18	13.54	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Feb. 7	4.70
" 8	4.70
" 9	4.70
" 10	4.70
" 11	4.70
" 12 Sunday	
" 13 Holiday	

Average week ending	
Jan. 2	4.70
" 9	4.70
" 16	4.70
" 23	4.70
" 30	4.70
Feb. 6	4.70
" 13	4.70

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	8.65	4.96	4.70	July	8.63	4.75	....
Feb.	8.88	4.54	....	Aug.	9.03	4.40	....
Mch.	9.22	4.06	....	Sept.	8.08	4.61	....
Apr.	8.78	4.32	....	Oct.	7.28	4.70	....
May	8.55	5.01	....	Nov.	6.37	4.70	....
June	8.43	4.57	....	Dec.	4.76	4.70	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	62.74	35.94	32.04	July	49.29	27.69	....
Feb.	59.87	32.16	....	Aug.	47.60	26.35	....
Mch.	61.92	28.87	....	Sept.	44.43	26.70	....
Apr.	62.17	30.36	....	Oct.	40.47	27.70	....
May	54.99	32.50	....	Nov.	36.97	28.93	....
June	48.33	29.39	....	Dec.	34.12	32.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	
Feb. 7	4.85
" 8	4.85
" 9	4.82½
" 10	4.85
" 11	4.85
" 12 Sunday	
" 13 Holiday	

Average week ending	
Jan. 2	5.17
" 9	5.10
" 16	5.11
" 23	5.04
" 30	4.93
Feb. 6	4.85
" 13	4.84

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	9.56	5.86	5.05	July	8.18	4.41	....
Feb.	9.15	5.34	....	Aug.	8.31	4.69	....
Mch.	8.93	5.19	....	Sept.	7.84	4.74	....
Apr.	8.76	5.37	....	Oct.	7.50	5.09	....
May	8.07	5.37	....	Nov.	6.78	5.18	....
June	7.92	4.96	....	Dec.	6.03	5.24	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
Jan. 17	50.00	Jan. 31	50.00
" 24	50.00	Feb. 7	50.00
		" 14	50.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	89.00	50.00	50.00	July	88.00	47.75	....
Feb.	81.00	48.75	....	Aug.	85.00	47.50	....
Mch.	87.00	45.88	....	Sept.	75.00	47.50	....
Apr.	100.00	46.00	....	Oct.	71.00	46.25	....
May	87.00	50.00	....	Nov.	56.00	40.40	....
June	85.00	49.50	....	Dec.	52.50	49.50	....

HOOVER ON THE RAILROAD PROBLEM

Herbert C. Hoover in a recent statement made to the Interstate Commerce Commission apropos of the railroad problem said in part:

"One thing is absolute. Our transportation facilities are below the needs of our country and unless we have a quick resumption of construction the whole community—agricultural, commercial, and industrial—will be gasping from a strangulation caused by insufficient transportation the moment that our business activities resume. Few people seem to realize the amount of expansion in our transportation machine necessary to keep pace with the growth of the country. And an equal few seem to have any notion of the price we pay for not having it.

"If we examine the fundamental reason for failure to resume equipment, we will find them in the loss of confidence in railways as an investment and the competition of tax-free securities. We have passed the period of credit strain in this depression. Surplus capital is pouring by hundreds of millions monthly into tax-free securities and foreign loans, and yet our railways are unable to finance the most moderate of construction programs.

"Far from it being impossible for our railways again to return to a profitable footing, I believe it is possible to demonstrate that on an average they will become very profitable. If we assume that the reduction of prices and wage-levels will settle at a plane no lower than 50% over pre-war, and if we assume that the present rates are to remain, and if we assume restored traffic, then the earnings of our railways would exceed 15% on the whole of the commission's tentative valuation. Surely there is room here for safety to investment, as well as relief to the shipper.

"In these circumstances it seems to me vital that the railways, as our greatest industry, should propose a courageous program of broad-visioned betterments, and, if necessary, the Government should consider giving the use of its superior credit. It would not cost the taxpayer a cent to give the Government guarantee to equipment trusts upon the primary responsibility of the railways, the proceeds devoted entirely to improvement and equipment.

"If I were to discuss the rates charged today I should say at once that a decrease in passenger-rates is not nearly so vital to the community as freight-rates, for passenger-rates do not enter into the 'spread' in proportion to the relative volume of earnings. If I were examining the freight-rates I should at once say that coal, metals, wood, and agricultural and other producers' goods should be reduced to the bottom before L. C. L. and class rates are touched.

"I would be willing to go even farther and say that I am convinced that even if the commission cannot at the present moment justifiably reduce railway incomes a single dollar, it is warranted in investigating the possibility of some relief to the more distressed commodities by a revision of some rates upward. With the gradual return of the traffic to normal, with decreased operating costs, relief in rates will be available, and it would be an economic crime to apply such relief by horizontal reductions to all rates, thus giving relief to higher priced goods and travel, when the vital mainspring of our economic life, our agricultural and fuel and metals are choked."

MONEY AND EXCHANGE

Foreign quotations on February 14 are as follows:

Sterling, dollars:	Cable	4.36½
	Demand	4.37½
Franc, cents:	Cable	8.68
	Demand	8.67
Lira, cents:	Demand	4.87½
Mark, cent:		0.51

Eastern Metal Market

New York, February 8.

All the markets are moderately to exceedingly quiet with the price tendency easy in some and steady in others.

Demand for copper continues very light and prices have again fallen.

The tin market has been spasmodically active with prices firm.

There is a steady demand for lead at unchanged and firm prices.

No improvement in demand for zinc is reported, but prices are unchanged.

IRON AND STEEL

A broadening demand, though without appreciably increasing tonnage, and still largely for replenishment, has marked the week. With it has come a crystallization of prices on heavy-tonnage products. Consumers may now buy bars, plates, and shapes in smaller lots at 1.40c., Pittsburgh, than they could a week ago. Higher prices obtain on orders in which delivery is a prime factor.

Railroad buying has been prominent and a large amount of passenger equipment is under negotiation.

January production of pig-iron was practically at a standstill as compared with December. The total was 1,638,697 tons, or 52,861 tons per day, as compared with 1,649,086 tons, or 53,196 tons per day in December.

Eight furnaces blew in last month and seven blew out. The number active on February 1 was 126 with an estimated capacity of 53,305 tons per day against 125 on January 1 with a daily capacity of 53,735 tons.

COPPER

There is little life to the market. As is often the case in this market, a period of inactivity of some length follows a buying movement and this is true of this period. Consumers bought freely in the last quarter of last year and they are also of the opinion that the starting up of the mines will relieve any possible shortage that has been predicted, especially in view of the quiet month just past. While some large producers are still out of the market, others are softening a little so that the quotation is 13.75c., delivered, against 13.87½c. and 14c. a week ago. Small producers and large dealers are freely quoting 13.50c., delivered, or 13.25c., New York, or refinery and are taking orders on what light demand prevails. Here and there a dealer or speculator sells an odd lot or two at 13.37½ to 13.25c., delivered. The general quotation for electrolytic, however, is 13.50c., delivered, or 13.25c., New York or refinery. Lake copper is quiet and lower at 13.50c., delivered.

TIN

The market for Straits tin is spasmodically active. On January 31 and February 1 and 2 there was very little business, but on February 3 and 4 the market was active. Previous to this there were sellers at prices which were higher than those which buyers were willing to pay, which caused stagnation. On the two days mentioned, dealers became buyers and on February 3 about 200 tons was sold at 30.75 to 30.87½c., all future delivery. On February 4, as a result of liberal inquiries from a large independent steel-maker, sales were made of forward metal at 31 to 31.12½c. Yesterday and Monday were very quiet with the quotation for spot Straits at 32c., yesterday, the same as a week ago. London prices yesterday were down £3 to £4 per ton from a week ago, with spot standard quoted at £155 15s., future standard at £157 15s., and spot Straits at £158 5s. Deliveries into consumption in January were 4275 tons with 1331 tons reported in stock and landing on January 31. Imports in January were 3910 tons against 1245 tons in January 1921. Arrivals thus far this month have been 670 tons with 8985 tons reported afloat.

LEAD

The market continues to follow a steady course, characterized by regular demand at unchanged prices. It is by far the strongest and most uniform of any of the markets. The leading interest continues to quote 4.70c., New York and St. Louis, while independents have a stiff minimum quotation of 4.40c., St. Louis, and 4.70 to 4.75c., New York and Eastern points.

ZINC

The market continues stagnant so far as demand is concerned. The only encouraging feature is that it has not declined in the last week as compared to declines almost daily for several weeks previous to this. In that sense the market is firm to steadier. Sales are confined to small lots for early consumption. Prime Western for early delivery is quoted at 4.50c., St. Louis, or 4.85c., New York.

ANTIMONY

In a quiet market wholesale lots continue to be quoted at 4.40c. per pound, New York, duty paid, for early delivery. Jobbing lots are about ½c. per pound higher.

ALUMINUM

This market presents no new features. The leading interest continues to quote virgin metal, 98 to 99% pure at 19 to 19.10c. per pound, f.ob. plant, depending on the quality in wholesale lots from 15 tons up, while importers of foreign-made metal of the same analysis quote 17 to 18c., New York, duty paid.

ORES

Tungsten: Demand is inconsequential and the market is, if anything, easier. Nominal quotations are down to a minimum of \$1.85 to \$2 per unit in regular Chinese concentrates, ranging higher as the grade of ore improves.

Molybdenum: Inquiry on a small scale is reported, but prices are unchanged at 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: There has been no business reported and quotations are nominal at 22 to 25c. per unit, seaboard. An investigation reveals that prospects of seeing Russian ore are not bright, owing to the demoralized condition of railroads and ports.

Chrome: The market is without feature and quotations are unchanged at \$20 up per unit, c.i.f. Atlantic ports.

FERRO-ALLOYS

Ferro-manganese: Because of the advance in the pound sterling in recent weeks British producers of ferro-manganese have increased their price for British alloy from \$58.35, seaboard, to \$62.50. Whether this will be followed by the Carnegie Steel and other American producers is not known. Sales are confined to small and carload lots. There are one or two inquiries running up to 500 tons. Production in January was 5644 tons.

Spiegeleisen: There have been sales of about 300 tons as well as some carload lots. Inquiries include about 500 tons. Prices are unchanged at \$26, furnace, for the 20% grade. Production in January was 1230 tons, the first substantial output since last July.

During 1921, in a period when many steel concerns operated at a loss, the Bethlehem Steel Corporation was able to show a balance for its junior stock of \$7.66 per share as compared with dividend requirements of \$5 per share.

Book Reviews

Manual of Determinative Mineralogy. By J. Volney Lewis. v+ 298 pp., ill. John Wiley & Sons, New York. For sale by 'Mining and Scientific Press'. Price, $3.

This edition, the third, of what is recognized as a standard text-book, is virtually a new treatise, being double the size of former editions. New physical tables for the identification of 290 minerals, without resort to the blow-pipe or chemical tests, are given, together with a condensed summary of physical mineralogy. Instructions for the use of the blow-pipe, blow-pipe tables for the determination of 355 minerals, a classification, according to lustre, crystallization, and hardness, are included. The glossary has been re-written and enlarged. It is intended that the use of the tables shall not only furnish a name by which a mineral may be called, but shall also lead the student to acquire a first-hand knowledge of what the mineral is, chemically and physically. The instructions and precautions that accompany the physical-classification and the blow-pipe tables have been written in order to aid the student in the development of habits of neatness, orderliness, and accuracy, and at the same time to inculcate a respect for mineral specimens, which are easily damaged or destroyed. The contents of the book are as follows: Properties of minerals. Physical tables. Determination by blow-pipe tests. Blow-pipe tables. Minerals classified according to crystallization. Glossary. Abbreviations.

Testing Electrical Machinery. By J. H. Morecroft and F. W. Hehre. D. Van Nostrand Co., New York. 220 pp., ill. For sale by 'Mining and Scientific Press'. Price, $3.

Contrary to the general impression in some quarters, engineering students at several American universities, including Columbia, are required to take courses in the electrical laboratories, testing both direct- and alternating-current machinery. This book has been compiled from notes made by the authors, who are on the professional staff at Columbia, to provide students in mechanical, metallurgical, chemical, and civil engineering with sufficient theory for a proper comprehension of the subject. Brief analyses of the characteristics of the machine are given before attention is paid to testing. Verbosity has been avoided, the idea being to present the subject-matter in such a manner that the student who is not well versed in the theory of electricity can get the maximum of information in the limited time allotted to the subject. The first edition of this book was published in 1911; the present edition, the fourth, contains much added matter. Since the third edition was published in 1915 the engineering courses at Columbia University have been put on a graduate basis; the amount of electrical work in the courses for non-electrical students has been increased considerably. Details have been added in connection with experiments on batteries, illumination, measurement of electrical energy, and other problems on which the average engineer frequently has to pass judgment; he should therefore have a passing knowledge of such features of electrical engineering.

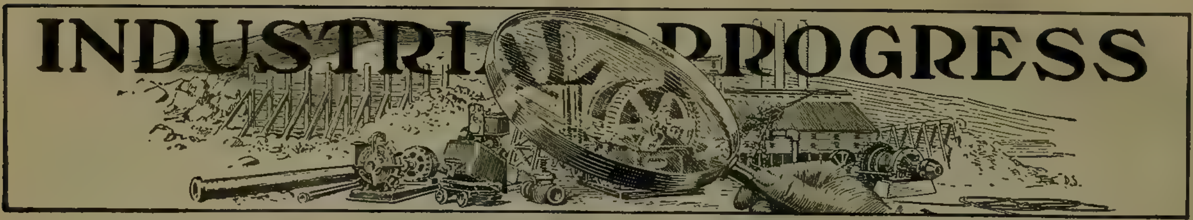
Design of Steel Mill Buildings. By M. S. Ketchum. 656 pp., ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $6.

The original edition of this treatise was published to provide a short course in the calculation of stresses in framed structures, and to give a brief discussion on the construction of mill-buildings. The present edition, the fourth, indicates that much has been re-written and that important additions have been made. A concise explanation is given of the method of calculation of the stresses in statically indeterminative trusses and frames, and several problems have been added in connection with framed structures, crane girders, roof trusses, and steel-frame buildings. As stated in the preface, the book is now divided into three parts. Part I covers the calculation of the stresses in simple beams, trusses, portals, the transverse bent, and the three-hinged arch. Part II covers the calculation of the deflections of structures, the calculation of the stresses in statically indeterminate girders, trusses and frames, and secondary stresses in trusses. Part III covers the design and construction of steel-frame buildings for mines, mills, smelters, and other industrial plants. The detailed design of a crane-girder, a roof-truss, and a steel building are given. The design and construction of floors, roof-coverings, foundations, corrugated-steel, windows, doors, wall-covering, and other details of steel-frame buildings are discussed fully. A complete specification for a steel-frame mill-building is given in the appendix. The book is a companion volume to the author's 'Structural Engineers' Handbook', both of which are recognized as authoritative.

Winning the Public. By S. M. Kennedy. McGraw-Hill Book Co., New York. 148 pp., ill. For sale by 'Mining and Scientific Press'. Price, $2.50.

The value of this book is shown by the fact that this is a second edition. The major portion of the chapters presented appeared in the 'Journal of Electricity' or in the 'Electrical World' during 1920; they created a deep impression. The author is the vice-president of the Southern California Edison Co., one of the largest public utility companies in the world. Mr. Robert Sibley, the editor of the 'Journal of Electricity', in the introduction, says that Mr. Kennedy possesses, to a degree perhaps unequaled by no other individual, an ability to sense the need for service, to visualize this need, and to put it into words so that the executive, the employee, and the man in the street may gather a clearer and more inspiring vision of the great need for service in present-day activities. The book contains no theories that have not been put into practice successfully, and no suggestions are made that have not been tried. Two additional chapters have been added, the contents now being as follows: Introduction. I. Transforming public opinion; greater service. II. The point of view; how the public judges; impressing the customer; how not to do it; the psychology of environment; the hospitable office. III. The value of courtesy; intangible assets; under a microscope; the corner-stone of success; the daily round; handling complaints; aggressive courtesy; a good investment. IV. The man in the street; the impressionist; the student; the human being; the customer; the investor. V. Room at the top; persistence; cheerfulness; soundness; loyalty. VI. Congenial contacts; letter writing; the telephone; personal contact. VII. That the people may know; financial news; power development; important extensions; power uses; personal items; welfare work; State regulations; distribution of news. VIII. The display room; appointments and methods; supplementary features; educational factors. IX. The spirit of progress; land transportation; electricity on the sea; invading the air; development of telegraphy; more light. X. The district manager; the organizer; custodian and guardian; administrator of funds; business builder; collector of revenues. XI. Potential publicity; classifying the public; the supremacy of the newspaper; central stations and co-operative publicity; accumulative advertising; being frank with the public; advertising copy; possibilities of the motion-picture. XII. The commercial instinct; visualizing business; diversity of load; recognizing friends. XIII. The art of conciliation; distrust; incentives to courtesy; selecting representatives. XIV. Service. XV. Cumulative co-operation. XVI. Over-complacency. XVII. Thankfulness.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

REMINGTON PORTABLE TYPEWRITER SHOULD BE POPULAR WITH ENGINEERS

The Remington Typewriter Co. is putting out a new machine known as the Remington portable which is attracting wide and favorable attention. It will be particularly interesting to mining engineers whose work takes them to out-of-the-way places where the heavier, larger machines cannot be carried.

One of the first things that will be observed about this latest Remington product is that it has the standard keyboard exactly like the big typewriters. This will be recognized as a big advantage by everyone having any familiarity with writing machines. From the standard machine to the Remington portable, or vice versa, is an easy transition. In either case the user has nothing new to learn and nothing to unlearn.

Remington Portable Typewriter

The new Remington portable typewriter also has an automatic ribbon reverse—the ribbon, from the time it is put on the machine until it is worn out, requiring no attention from the operator. This also is said to be a new feature among portable typewriters. Among the other standard features on the new Remington portable is the back-spacer key, variable-line spacer, type-guide, line-lock, line-indicator, and adjustable marginal-stops—in fact the Remington portable contains practically every feature common to the larger machines.

When not in use a swift motion locks the carriage. This feature makes the machine, when carried in the case, as rigid as the case itself. The machine is permanently attached to the baseboard of the case which eliminates all tendency to 'creep' when operated. This baseboard makes its use easy and convenient under all conditions—even on your lap.

In view of its many standard devices it is surprising to hear that this machine actually fits in a case only four inches high—in fact this case in cubic-inch dimensions is said to be the smallest case used for any portable typewriter. The machine is very compactly and solidly built and in strength and dependability it is in every way worthy of the famous name it bears.

The weight of the machine complete with carrying-case is only 11½ pounds.

An illustrated folder describing the Remington portable will be sent on request to the Remington Typewriter Co., 374 Broadway, New York.

THE DURABILITY OF WOOD-STAVE PIPE

The following discussion of the merits of wood-stave pipe is found in a recently issued pamphlet published by the Pacific Tank & Pipe Co. Evidences of the great durability of lumber well saturated with water are so numerous, and come from such reliable sources as to establish the fact beyond the necessity of any further discussion. Many samples of bored-log water-pipe have been recovered in a high state of preservation after lying in the ground more than a century. Engineers and architects have not hesitated to erect great structures on piling foundations, and the proof is cumulative that wood buried below the water-table, so as to ensure thorough saturation, is practically indestructible. In a pipe-line, it is evident that the wood may readily be kept in a state of constant saturation, not only by capillary attraction, but by the pressure of the water itself.

In the building of Pacific wood-stave pipe, great care is taken in the selection, seasoning, manufacture, and inspection of the staves of which the pipe is built, and it is reasonable to assume, and experience and installations have proved that the life of these staves, when used for conveying water, will be in excess of the metal with which the pipe is banded. The life of Pacific wood-stave pipe is therefore dependent on the banding which supplies the necessary strength to hold the staves together. In banding, all conditions that might affect the life of these bands are taken into consideration. The material of which the bands are composed is of the very best kind that can be obtained, and is selected with a view to long life. The pipe is banded so as to give the greatest cross-section with the least surface exposed, at the lowest possible cost, care being taken to ensure ample strength. The steel banding is of a special composition, the result of many years of study and experiment, first cost not being the deciding factor in its selection. It is over-size in cross-section and is protected by various means, such as the highest grades of galvanized and asphalt coatings of tested preservative qualities.

A comparison of Pacific wood-stave pipe with iron or steel pipe brings out the fact that in iron or steel pipe the metal has a dual function to make the pipe tight and to resist internal pressure. Both of these classes of pipe fail by pitting, and although they may be amply strong to resist far more pressure than they are designed to withstand, at the same time they may be rendered useless, owing to the fact that corrosion on both the inside and outside has pitted the metal, causing the pipe to cease being water-tight.

On the other hand, it is a well-known fact that the elements which act as corrosive agents, tending to break down the material of which metal pipe is constructed, have no appreciable effect on wood-stave pipe. The water flowing on the inside of wood-stave pipe preserves the wood and does not come in contact with the banding, and, therefore, tends to prolong the life of the pipe, instead of shortening it; and this is true, even though the water may contain a certain amount of acids or minerals.

Fifteen years ago we installed a distributing system for the city of Eureka, California. Recently the engineers for the State Railway Commission based their valuation on a period of 35 years usefulness for the wood pipe, though the city contended that 50 years would be more nearly true. The United States government bases its calculation of interest and depreciation on a life 'in excess of 25 years'. Data on Pacific machine-banded wood pipe are available since 1895, and the condition of many installations made since that time leads to the conclusion that the estimates cited are both conservative.

PENSACOLA TAR PRODUCTS CO. ACQUIRES RIGHTS IN THE WERNICKE SECTIONAL RETORT FOR WOOD-DISTILLATION

The Wernicke sectional retort for the distillation of the products of pitch pine and other kinds of wood is a comparatively recent development. The Pensacola Tar Products Co., of Gull Point, Florida, has secured exclusive rights for the device in the United States. The retort is suitable for the production of the crude product by small operators.

In designing the Wernicke sectional retort, the prime factors held in mind were adaptability, safety, economy, and dependability. One of its novel features is the principle that ensures an even distribution of the heat over the entire surface of the retort, whereby the obtainable products are greatly improved in quality and increased in quantity.

The retort is portable, easily put together, safe, and simple of operation and may be taken down, moved, or reassembled. There are no difficult operations requiring special tools. All can be done by unskilled labor with hammer and wrench. The construction and plan of operation overcomes all danger from explosions, which have proved so costly and disastrous where defective construction and faulty methods were permitted.

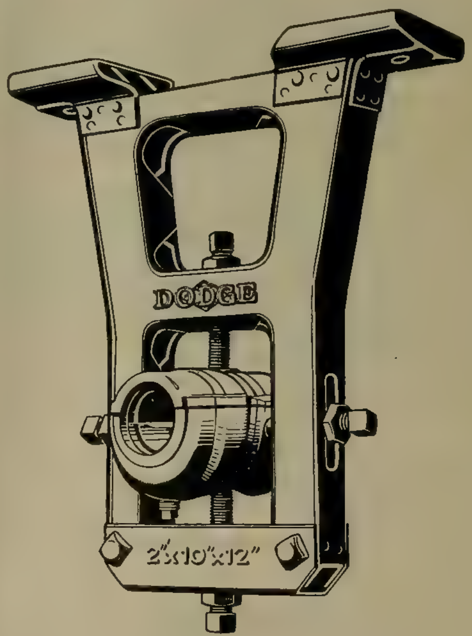
The 'pyro' acids resulting from wood-distillation attack ordinary steel and iron. Their action on seams and rivets is particularly destructive, causing leaks which necessitate frequent and costly repairs. The Wernicke retort does away with objectionable riveted seams and joints. The cylinder is made of special acid-resisting metal with 4-in. turned flanges at both ends to which the retort-heads are bolted and made safe from leaks or acid action by intervening copper-gaskets. The retort heads and door are built up in three layers, two of metal with asbestos between them to prevent condensation and loss of heat. This is a matter of vital importance in the operation of retorts.

The entire surface of the Wernicke retort is heavily insulated, like a fireless cooker, so it will retain the heat. The result is economy of fuel, uniform temperature, better product, and higher yield. The four-inch covering for the retort cylinder is cast in sections to fit their places and is made from a composition of calcined celite and cement. The laminated door is made of special sheet metal and asbestos, is very light, and provides a positive seal against gas-leaks which are so annoying and dangerous, where cast-iron heads and doors are used as with the ordinary retorts. The retort is supported on steel posts by flanges firmly fixed to the cylinder, the furnace is suspended from the same posts and its outer walls are of carbon steel. The furnace front and firing door are cast iron. All parts are detachable. The furnace is arched and lined with the same composition as used to cover the cylinder.

Of equal importance to a properly constructed retort and uniform heat distribution to ensure a good yield of high-quality products is the matter of saving them. This can only be done by adequate condensation, otherwise the lighter and more valuable products escape and are lost. Good condensation is a matter of adequate cooling-surface and ample cooling-water. The condenser that the company recommends contains 545 linear feet of 1¼-in. copper tubes which are immersed in flowing water while in operation and provide adequate condensation for the capacity of this retort, while kept clean and supplied with plenty of cold water.

A PRESSED-STEEL SHAFT-HANGER

The Dodge Sales & Engineering Co. of Mishawaka, Indiana, announces that it has perfected, after two years experimentation in construction and design, a pressed-steel hanger for general uses. The Dodge pressed-steel hanger represents the most advanced development in general-purpose hanger construction under conditions which permit its use, and where extreme vibration is not a factor. In offering to power users the pressed-steel hanger, the Dodge organization does not unreservedly endorse steel hangers regardless of their construction for every purpose, but they simply recognize a demand for a line-shaft hanger of lightness and strength to serve under conditions not severe or unusual and where first cost is of guiding importance. The Dodge pressed-steel hanger is now available through Dodge, Oneida, and Keystone dealers for immediate delivery.



An Improved Pressed-Steel Shaft-Hanger

OUTSPINNING THE SPIDER

Wire rope is one of those products which is taken for granted. There are few persons who are not familiar with the romance of steel and other large industries of the country, but up to the present the story of wire making in America has never been told. It is this void which is filled by 'Outspinning the Spider'. The book is written in a popular vein, understandable to the layman, and in no meaning of the term is it technical. The author is J. K. Mumford. For the most part it relates the growth of wire-making as reflected in the growth of the John A. Roebling Son's Co.

The founder of this company, John A. Roebling, back in 1837 as a young engineer wrestled with the tedious problem of hauling Pennsylvania canal boats up the Portage railroad which Bertrand, one of Napoleon's generals, had built to overcome the Pennsylvania ridges. The haul was made by means of huge and cumbersome hemp ropes. Roebling read in one of the papers that had been sent to him from Germany that some one in Freiberg, Saxony—where wire-drawing had its birth—had made a strong rope by twisting wires together, and the young engineer conceived the idea of utilizing this twisted-wire rope on the Portage railroad.

It was in 1840 that the first Roebling rope was finished. John Roebling had a vision of the part that wire rope was to play in the industrial development of the world and from the start realized the universal mission of twisted wire. Wire rope, spreading its field of utility wider and wider, carried with ease and safety loads that "had broken the back of hemp".

Wire cableways for hauling material over rivers and gorges soon ceased to be a novelty. Despite the opposition of engineers and others Roebling by 1844 had not only perfected his theory of wire bridges, but in spite of criticism had built a wire bridge as an aqueduct for the Old Pennsylvania canal, the basins of which were at Pittsburgh. This was followed by the construction of a wire bridge over the splashing and fuming waters of Niagara, the first of its kind to carry railroad traffic.

The summit of achievement in the building of bridges of wire came with the construction of the Brooklyn bridge, considered the Eighth Wonder of the world. It was while occupied in this work that John Roebling sustained a slight injury that resulted in his death. 'Outspinning the Spider' relates in a vivid way the various processes used, the exacting care necessary in its manufacture, and a few of the various uses to which wire rope is put.

THE IMPORTANCE OF EFFICIENT BEARINGS FOR CONVEYOR-BELTS

The Hyatt Roller Bearing Co. of New York points out five advantages of equipping conveyor-belts with the most efficient bearings. These are reduction in (1) power to operate; (2) initial cost of belts; (3) belt-replacement cost; (4) idler repairs (labor and materials); (5) lubrication costs (labor and materials).

1. Power. Hyatt roller bearings provide a true rolling motion in place of the dragging friction of plain bearings. When applied in the hub of idler-pulleys, therefore, they reduce this friction at least 50%, resulting in a worth-while reduction in power as most of the power required by a conveyor is used to overcome the friction in the idlers. This makes possible the use of smaller driving motors and lighter head and tail mechanism as well as reducing power costs.

2. Belt cost (initial). The necessary number of plies in a conveyor-belt is determined by the tension under which the belt will be operated. This tension is caused by friction in the idler-pulleys and, therefore, reduction of friction will reduce the belt-tension and reduce the number of plies. When a six-ply belt can be used instead of an eight-ply belt a considerable saving in first cost results.

3. Belt cost (replacement). Conveyor-belts wear out in three ways, by abrasion caused by the material they carry, by sliding instead of rolling over idler-pulleys, and by being pulled apart because of tension due to idler friction. Abrasion can only be reduced by properly designed loading chutes, but wear due to idlers and to pulling apart is prevented by Hyatt-equipped idlers which always turn and never stick.

4. Idler repairs (labor and materials). Ordinary plain-bearing idlers wear out in two ways: in the bore or on the face. Hyatt roller bearings are durable and operate for years without perceptible wear and thus eliminate wear in the bore. Hyatt-equipped idlers turn so easily that the belts roll over them without friction and the idler faces are therefore not worn out.

5. Lubrication costs (labor and materials). Hyatt-equipped idlers require oiling only three or four times per year. This means a real saving in grease and the labor to apply it.

COMMERCIAL PARAGRAPHS

The Bucyrus Company, South Milwaukee, Wisconsin, with North-Western sales office at 608 Pittock Block, Portland, Oregon, announces the appointment of A. R. Hance as North-Western sales-manager, succeeding L. T. Russel who has resigned after ten years of service with the company. Mr. Hance has been connected with the sales department of the company in the Central and Eastern territories for a period of six years and comes to the North-West with a thorough knowledge of the company's product.

The Denver Fire Clay Co., of Denver, Colorado, has just issued a new bulletin entitled 'D.F.C.' Oil Burners'. The first 21 pages of this booklet are devoted to a general discussion on the burning of fuel-oil. It deals with the characteristics of different oils and with the principles underlying efficient combustion. The important features of the D.F.C. low-pressure burner are discussed and other types of burners are described. The pamphlet may be had on application to the company. It is well worth having.

'Calite' is an alloy that is cast in the usual forms in which steel and iron are cast, and is for use in high-temperature work. Calite castings are made under patents of the **General Electric Company** and are recommended for use in temperatures as high as 2200°F. Calite containers are used for carbonizing or case-hardening, annealing, heat-treating, and for holding molten lead, various salts, and cyanides. Castings are also adaptable for furnace-parts, heat-exchangers, recuperators, etc. The characteristics of the metal follow: Melting point, 2777°F.; softening temperature, 2500°F.; safe working temperature, 2200°F.; maximum working temperature, 2370°F.; specific gravity, 7.03; weight per cubic inch, 0.25 lb.; specific heat 100°C. to 15°C., 0.123; thermal conductivity, 25% of iron; and shrinkage (molten to cold), ¼ in. per foot. Its physical properties are: Elastic limit, 36,800; reduction of area (cast), 2 to 3%; elongation, 1%; Brinell hardness (annealed), 286; scleroscope hardness (annealed), 40; and transverse strain test, 1-in. square bar on 12-in. supports, 4250 pounds.

Work has been started at the plant of the **Westinghouse Electric & Manufacturing Co.**, at East Pittsburgh, on the largest single order for electrical transformers ever placed, according to announcement made by officials of the company. The order was received by the **Westinghouse Electric International Co.**, through its Japanese agents, Takata & Co., of Japan. The contract calls for 34 transformers, averaging 9400 kva. each, a total of 316,400 kva. The transformers will be single-phase, 60-cycle, oil-insulated, and water-cooled, and will have a high voltage of 154,000, which is the highest voltage in commercial use at this time. When installed they will weigh 50 tons each. The Daido Electric Power Co., of Japan, will install these transformers in a super-power system in the industrial district about Tokyo. This super-power zone is similar to that now under consideration for the area between Boston and Washington. One of the Japanese stations, planned for Furukawabashi, will contain 18 transformers with a total output of 169,200 kva.; another at Ohi will have nine transformers with a total output of 82,800 kva., a third at Suhara will be equipped with seven transformers with a total output of 64,400 kva. Eleven months will be needed to complete the record-breaking order which calls for an expenditure of approximately $2,000,000 for the entire equipment.

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1318-22

T. A. RICKARD, • • • • Editor

THERE is scope for ingenuity in connection with the reclamation and the economical utilization of what is considered as waste material. The ladders used in the freight-cars of one of our largest railroad systems are now being made of discarded boiler-tubes. Engineers in isolated places often make use of such material because of necessity; but efficiency and economy are equally good motives.

SHAFT-SINKING does not provide the only opportunity for an endeavor to break records. The Chief Consolidated Mining Company is to be congratulated on the prompt appearance of its report for 1921. In this Mr. Walter Fitch, Sr., states that conditions at the property continue to be satisfactory. Progress has been made in securing additional mines on reasonable terms. The acquisition of the Grand Central mine on January 7 will doubtless prove a profitable venture, although much of its earnings in the near future will be needed for adequate development. A note of optimism is sounded in regard to the probable reduction of charges for freight and treatment.

ONE of the privileges of a technical journal is to afford a wider publicity to the special contributions that are published occasionally by professional societies of limited membership. A few months ago we drew attention to the part that science has played in furthering precision in industrial work, to the distrust of vague generalities and to the encouragement of accuracy. In regard to the ventilation of mines, it was realized at a comparatively recent date that quantitative estimations as well as qualitative tests were necessary; hence the need arose for an instrument to measure the cooling-power of the atmosphere, of wind, and of air-currents. Dr. Leonard Hill is a physiologist who has met with much success in the practical application of his ideas on personal hygiene and the ventilation of industrial plants. Recently he was invited to prepare a paper on ventilation and human efficiency for inclusion in the transactions of the Institution of Mining & Metallurgy. We reproduce this on another page. Although not a member of the Institution and only indirectly interested in mining, Dr. Hill has written a paper that will take its place among the most important on the subject—one that should receive the thoughtful consideration of all employers of labor underground. The scientific study of such problems is performed best by a specialist. Science knows no boundaries; its application to industry will be facilitated by the adoption of a liberal and hospitable attitude toward specialists in other fields of endeavor. We congratulate the Institution on the publication of so valuable a paper.

STATISTICS given by Mr. J. C. Hannon, a member of the British Parliament, recently quoted in the 'Valve World', give the purchasing value of one ounce of gold in terms of hours of labor as follows: in the United States, 17.22 hours; in Great Britain, 50.16 hours; in Japan, 95.50 hours; in France, 117.31 hours; and in Germany, 201.66 hours. The products of American industry, directly or indirectly, come into competition with those of other nations. If this competition is to be met successfully the American workman must be able to accomplish as much in 17.22 hours as a workman of another nationality does in a much longer period, assuming that he opposes any reduction in his hourly wage-rate. He does not wish to give more hours for each ounce, therefore he must give more work in each hour. This does not mean necessarily that he must work harder but that he must work more effectively. His efficiency depends partly upon himself, partly upon his employers, and partly upon his co-workers; but in some way it must be made to exceed that of others if competition is to be possible. Even when the exchange-rates have readjusted themselves, and tariff-walls have given a measure of protection, the worker in the United States will be faced with the necessity of accomplishing much more in each hour than does his competitor in a foreign country.

SOME folks have criticized Secretary Hoover on the ground that he was too much of an internationalist; they should ponder the following statement made by him in a recent discussion of the railroad problem: "We talk glibly of giving billions of credits to foreign countries to increase our farm exports. I wish to say, with all responsibility for the statement, that $1,000,000,000 spent upon American railways will give more employment to our people than twice that sum expended outside the frontiers of the United States". That is sound American doctrine and eminently sensible. There may be difference of opinion as to who is responsible for the plight of the railroads, but there is no question as to the sore need for additional track and additional equipment. If construction were resumed on a scale commensurate with the needs, mines and factories and farms would immediately feel the effect. Prosperity comes or goes with adequate employment. Secretary Hoover suggests that the Federal government should guarantee, under suitable safeguards, bonds that would serve to raise the necessary money to finance improvements, at an interest-rate that the inferior credit of the railroad companies themselves does not warrant. This would not cost the Government one cent, but it would permit the performance of much-needed work.

What Ails Pioche?

Pioche is ailing. As to that there is no question; nor is there room for doubt that besides the general industrial depression a more deep-seated cause of trouble exists. The diagnosis of the illness requires no unusual acumen; a number of engineers and geologists have analyzed the case carefully enough to know that a few major operations and a severe course of treatment are indicated. It is not certain, however, that the patient would respond as successfully as anticipated, nor that the chances of his future usefulness are sufficient to warrant the attempt to cure the ailment. We observe in a news dispatch that a number of engineers have just been at Pioche, among them being Mr. George M. Fowler, geologist for the Anaconda Copper company, Mr. A. C. Boyle, geologist for the Union Pacific Railroad Company, Mr. R. T. Walker, of the exploration department of the United States Mining, Smelting & Refining Company, and a group of engineers for the St. Joseph Lead Company. Although we hesitate to implicate all of these men directly in the study of the problem whether Pioche justifies an attempt to renew its old-time vigor, their visits are at least suggestive.

Pioche is suffering from three things. The first is the low price of lead; but, in this respect the old 'camp' is no worse off than any of the other base-metal producing districts. Like winter and summer, high prices and low alternate with each other, and they always will; Pioche cannot spend the season in an economic California or Florida, so she will have to weather the winter of low-priced lead as best she can, hoping that the winters that are sure to come will be much less long and much less severe, and remembering that summers must intervene. And that bit of philosophy is equally good for Bingham, Butte, and Bisbee. The second source of trouble for Pioche is high freight-rates on ore and concentrate that must be shipped several hundred miles to one of the smelters in the vicinity of Salt Lake City. The mining companies at Pioche always felt that the rate-making officials of the Los Angeles & Salt Lake Railroad Company took an undue advantage of the absence of competition in the hauling of Pioche ore. A short branch connects with the main line at Caliente. Since the Union Pacific company acquired the control of the Salt Lake Route, as the railroad was known, efforts to obtain lower rates have been redoubled, and it is not improbable that the visit of Mr. Boyle is one of the consequences. His visit should result in a clearer understanding on the part of the railroad company of the needs of the district and likewise of the increased volume of traffic that can be expected to result from the establishment of lower rates. If Mr. Boyle in his capacity as geologist is convinced that traffic can be expanded sufficiently, he may be able in his capacity as physician to prescribe a tonic of lower freight-rates. That will help, of course; but like all tonics it will have its limitations; it cannot take the place of a major operation.

Pioche is far from being on its death-bed; it has many years ahead yet, even if the operation is never performed; but there is a reasonable probability that it may again be one of the important producing mining districts of the country if the proper steps be taken. To explain conditions, a glance backward is necessary; as the doctors say, we must have the history of the case. In the early 'sixties a number of mines were opened in lenses of high-grade lead-carbonate ore, rich in silver. Prominent among them was the Raymond & Ely, which now forms the nucleus of the holdings of the Amalgamated Pioche company, at the head of which is Mr. H. R. Van Wagenen. About 1870, nine different mills were in operation at Bullionville, ten miles distant, where water was available. The owners hauled ore to the water instead of pumping water to Pioche. Pan-amalgamation was used for the recovery of the silver, which was shipped by pony express to Springville, Utah, the nearest railroad point. The ore, it is said, was so rich that the mullers would stick and the mills had to be stopped and scraped several times each day. The town had a population of 10,000 and took a back seat to none of the thriving and thrilling silver camps of the period. The panic of '73, however, found Pioche already slipping, for the reason that many of the mines had reached the water-level, where within a distance of a few feet the ore gave place to a complex sulphide that assayed like ore but was not 'ore'—then. Most of the 10,000 necessarily departed; some remained, and operations were continued on a reduced scale in the oxidized zone. A little later the father of Messrs. Murray C. Godbe and Anthony H. Godbe, who now administer the affairs of the Prince Consolidated company, purchased the accumulated tailing from the mills at Bullionville; much of this, according to authoritative records, assayed as much as $80 to $100 per ton. Some of this tailing was shipped by team to Milford, in Utah, to which the railroad in the meantime had been extended; most of it was re-ground and again amalgamated in pans. Later the tailing was passed over vanners for the recovery of the lead, thereby winning a good profit. Part of the proceeds was spent by the Godbes in opening the Prince Consolidated mine, which, above the water-level, has yielded well. The records are not accurate, but it is certain that many million ounces of silver and thousands of tons of lead have been produced from the ore in the oxidized zone. The significance of this past production is the proof that the orebodies are large and rich; the inference that the valuable metals are present in the lower horizon is supported by geological evidence and deductions. A large amount of silver ore containing a high proportion of iron and manganese, which make it particularly desirable for the smelters, has been shipped to the plants in the Salt Lake valley. During the War the Amalgamated Pioche company treated a mixed lead-zinc sulphide ore by concentration; the lead was first removed on tables and the zinc was recovered by flotation. In this particular ore the minerals of lead were in crystalline form and therefore were comparatively easy to separate. Nearly all the sulphide ore, however, that has been revealed thus far contains lead and zinc in exceedingly intimate mixture. The existence of the ore has been disclosed in a great many places, but almost no development has been attempted. Some experimental work has been done on the metallurgy of this ore, but without any definite results. Two things are essential: (1) the sulphide zone must be explored; the geologic indications that point unmistakably to the existence of huge deposits of good ore must be verified by systematic digging, and (2) a metallurgic treatment must be devised by which an economical separation of the metals can be effected. The problem is probably no more difficult than that of treating the ore from the Star mine in the Coeur d'Alene region of Idaho. It is not insurmountable, but it may require a year or perhaps several years to develop a suitable process; specialists for the Bunker Hill company have been working for a long time on the Star ore, and they have only recently announced definitely that a successful process has been devised. Thus far no one has appeared who is ready to advance the money required to do these two things. The diagnosis, as we have said, has been made; it remains to find someone who is willing to assume the risk of attempting a cure for the vital ailment that threatens Pioche. Vision, courage, and persistence are needed in addition to technical skill. That they will be forthcoming we have every confidence.

Arthur Thacher

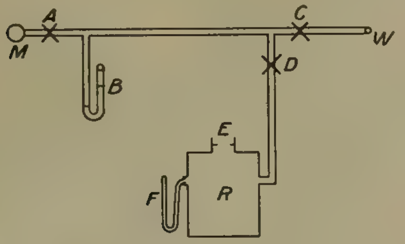
St. Louis became prominent as an American mining centre when a number of its citizens grew wealthy by reason of the bullion that was yielded by the Granite Mountain mine at Philipsburg, Montana. That was 35 years ago. The Granite Mountain distributed thirteen millions of dollars among the people of St. Louis and stimulated the market for silver mines in that city. We are not forgetful of the fact that St. Louis was the distributing centre and in a measure a financial centre for the lead mines of south-western Missouri, at first for Joplin and later for the Miami and Picher districts, which transgress the boundary of Missouri and extend into both Kansas and Oklahoma; nor do we overlook the Flat River district and the celebrated Mine La Motte, which was productive for nearly two centuries. Nevertheless the flush days of the Granite Mountain marked a period when St. Louis was most prominent in Western mining, for they coincided with the successful development of Butte and Leadville. Many mining engineers found scope for their abilities in these operations. We have interviewed two of them: first Mr. Philip N. Moore; now Mr. Thacher. Both are New Englanders by descent and come from the old stock that has leavened the lump of American nationality. Both graduated from the Columbia School of Mines. Both therefore had a preparation, hereditary and educative, fitting them for a useful career. As usual, Mr. Thacher's first opportunity for work—his first 'job'—came through the kindness of a friend. Young graduates are inclined to think that their degree is a ticket to employment; they do not realize that as technical fledglings they are not worth the first salary they are paid, and therefore that they owe their entry into practical life to the goodwill of a friend. He gives them the chance to make a start and to make good. Every engineer will recall the friend to whom he owed his start, and ought to cherish his memory with gratitude. Indeed, one of the privileges of the older men is to give a helping hand to the young fellows. Mr. Thacher owed his start to Charles Tilton, of a firm still honored at Portland, Oregon. He came to San Francisco and went to the Progreso mine, which continues in operation and is about to be acquired by the Boleo company, one of the most successful of French enterprises on this continent. His door of entry was assaying and surveying, occupations that have provided bread and butter for many young men at the beginning of a mining career. Mr. Thacher had the good sense not to stay too long at one mine but to spend his years of least responsibility in widening his experience. So he went to Arizona. There he came to grips with the realities, by engaging in contracting and prospecting, both of which gave him an idea of the value of money and of the need for applying business principles to mining. It was a good start. Later he supplemented this practical training by reverting to a scientific education, for, as he himself says, the five years that he spent at Washington University in association with Professor Potter were to him a post-graduate course, of which he made the best use. Indeed, if life were not so short, it would be well if all of us could return to college after our first ten or fifteen years in the field, for by that time we have learned how little we know and we have discovered the things that we need most to know. When Mr. Thacher left Washington University he lost no time in getting into harness as a manager of a mining enterprise. He was fortunate in being connected with one that proved successful—so successful as to be bought at a handsome price by the Guggenheims twelve years later. The task that brought him a modest fortune and an honorable reputation was his reorganization and management of the old Central Lead Company's property in the Flat River district of south-eastern Missouri. Under discouraging circumstances he developed this enterprise to a successful issue; he carried it through the period of depression in the early 'nineties when lead fell to a price of less than 2½ cents per pound; by aid of tact and persistence he more than held his own against overweening competitors, bringing the property to a condition so prosperous that the Guggenheims purchased it for a million and a half dollars without any commissions. The best mine in the group was under water at the time the sale was made, and the buyers acquired it on the strength of Mr. Thacher's own statement concerning its ore-reserves. His work, among other things, involved the application of geology, for he surmised that the lean orebody exploited by his predecessors was not the main ore-horizon of the district, so he sank the main shaft deeper and opened up one of the richest and largest of the orebodies found in the 'disseminated lead' belt. It was his confidence in his own judgment that caused him to buy large blocks of shares from the old stockholders. During his management of the Central Lead Company he had his first contact with the labor problem, a subject in which he has retained an eager interest ever since. Although a man of generous spirit, and what one may call economic sympathy, he has no faith in the ordinary methods of collective bargaining, and does not hesitate to give his reasons therefor. On the other hand, he is a keen advocate of friendly co-operation between employer and employee, and believes sincerely that the compelling motive to good work is not the wages alone, but the desire for achievement; in short, he credits the workman with what most of us arrogate to ourselves as the professional spirit. His advocacy of the secret ballot at the meetings of labor-unions is one that will commend itself to those familiar with the manner in which the unions are dominated by the rougher and less responsible element. Many strikes are started by an open vote in the small hours of the morning, by which time most of the quiet men have been intimidated either into acquiescence or departure, and at an hour when most of the married men have gone home. What unionism needs is the participation of all the workers in the system of collective bargaining, not domination by a coterie of radicals. We understand the laboring-man's dislike of the 'scab'—the laborer who takes the place of a striker—and believe that it is best for our economic system that all laborers should join their unions, especially the married, conservative, and more intelligent type of workman. Mr. Thacher gives his views on the subject in an outspoken manner; he speaks with the confidence of experience and the sympathetic insight of a humane man. The figures he quotes, to show the output per day in the Wisconsin zinc region, are most significant as showing what can be done when men are treated properly. Our readers are aware that Mr. Thacher's name was mentioned recently in connection with the presidency of the Institute, and it was by his own wish that the matter went no further at this time. He has been, and continues to be, a loyal and effective worker for the Institute. What he says concerning the system of representation is much to the point. The directorate has been a figure-head affair because out of a board of 24 only six or eight—those resident in New York or near it—attend the meetings. The effort to establish representation by means of directors from the outlying Sections has proved a disappointment because men living at a distance from New York have found it impracticable to attend the directors' meetings. The result, inevitably, has been to throw the control of Institute affairs into the hands of a small group in New York—in short, the control has been distinctly oligarchic, instead of republican, as it is bound to be when headquarters are at one end of a continental country 3000 miles wide. The Institute, like many another expression of modern—especially American—enterprise, is suffering chiefly from bigness, with which goes shapelessness, mere bulkiness, like a fat man with a weak heart. Mr. Thacher discusses this phase of the subject in his replies to the interviewer; he also answers frankly the questions submitted to him on the subject of the Institute magazine. Next we come to Mr. Thacher's ideas on education. He has been a teacher himself, and he has seen enough of the results of conventional education to be able to speak confidently. It is interesting to note his advocacy of a cultural training for engineers; he recognizes the power that comes to men from their ability to express themselves, and he has seen many examples of effectiveness that were frustrated by the inability to speak and write efficiently. The interview closes on a cheerful note, for Mr. Thacher asseverates his complete confidence in the revival of mining and in the continued expansion of the industry. At the time of our interview the outlook was not as good as it is now, but these periods of depression are a necessary part of human life in its broadest sense, and it is the sign of a healthy mind to be sanely optimistic. Only the old, the sick, and the distempered remain pessimistic for long. A cheery forward-looking temper is essential to sane living; without it we could accomplish nothing. Mr. Thacher has that temper or temperament; he belongs to the cheery, helpful, and kindly type of men, willing to assist in all good works and ready to give a cordial hand to his fellows; but no cynic can say that his kindliness marks weakness; on the contrary, he is a man of essential courage—moral and physical. We recall the stories told us about the way he acted during the strike in south-eastern Missouri when his mill-crew refused to do a few minutes work outdoors to move a railroad-car, and how he discharged them promptly, causing the strike to spread and the pump-men to 'come out', so as to drown the mine, in which condition it was when the Guggenheims acquired it, practically on Mr. Thacher's estimate of the ore-reserves. He is not only honest in the ordinary sense, of course, but he has the much rarer quality of intellectual honesty; he thinks honestly. The interview suggests that. He is not a man that plays much; his pastime is to think and talk. He has no hobbies but his friends. He is eminently sociable, using that word in its economic sense. During the years immediately before the War and even during the War period, in the face of advancing wages and the decreasing efficiency of labor, he has been able to show, from year to year, lower costs, higher wages, and larger output per man per day. This he accomplished largely with green foreign labor, in a non-union district, by virtue of his own friendly methods. That is an achievement of which an engineer may be proud.

Measurement of Air

The Editor:

Sir—In the issue of April 20, 1912, a method of measuring low-pressure air was described by G. S. Weymouth. I have had occasion to measure the volume of air drawn into a centrifugal pump that was being used as a flotation agitator, and made use of the following modification of the original method:

Weymouth's arrangement for low-pressure air measurement is so useful that the repetition of the diagram is justified:



M = high-pressure air-main
A = valve, to work to be measured
B = mercury-gauge
C = valve to agitator, etc.
D = valve to instrument
R = receptacle with E = diaphragm
F = water-gauge
V = volume of air, cu. in. per min.
d = diameter of orifice, in.
h = water-gauge reading, in.

OPERATION. Set D closed, C open, regulate A until the air-lift and agitator at W is in normal operation. Read gauge B. Open D and close C. Regulate D until the gauge B reads the same as before, proving that the resistance through the system DRE is equal to that which existed through CW. The diaphragm E is to be chosen with an orifice of such diameter, d, that the reading of gauge F is about 1 or 2 in. $= h$.

Then, 1 cu. ft. air at 62°F., and 29.92 in. Hg = 0.0761 lb.
1 " " water .... = 62.5 "

$$\frac{62.5}{0.0761} = 821$$

Velocity $= \sqrt{2gh}$ ft. per second, where h = ft. of water

$= \sqrt{2 \times 32 \times \frac{h}{12} \times 821} \times 12 \times 60 =$ in. per min.

$= \sqrt{h} \times 66.1. \times 12 \times 60$

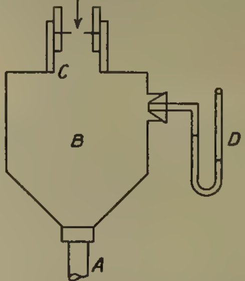
$= \sqrt{h} \times 47592$ in. per min.

Area of aperture $= \frac{\pi d^2}{4}$ with d in inches

Coefficient of flow = 0.64

Volume $= \sqrt{h} \times 47592 \times \frac{\pi}{4} \times d^2 \times 0.64 =$ cu. in per min.

$= 23921\, d^2 \sqrt{h} =$ cu. in. per min.



FRY'S ARRANGEMENT FOR MEASURING AIR UNDER SUCTION

A = pipe through which air to be measured is being sucked into machine, controlled by the valve between B and pump
B = receptacle with C = diaphragm
D = water-gauge
V = volume of air, cu. in. per min.
d = diameter of orifice, in.
h = negative reading, in.

I chose d so that the reading h did not exceed 2 in. The oil in use for flotation was in small quantity so it was dropped upon diaphragm C and allowed to enter with the air. The diaphragm was of thin tin-plate, held with insertion-rings beneath and above, between the halves of an ordinary pipe-nipple held in a pipe-socket. Changes of diaphragm could be readily made by unscrewing the upper half of the nipple. An orifice of $\frac{1}{8}$ in. was found suitable for 1000 cu. in. of air per minute. As before, $V = 23921\, d^2 \sqrt{h} =$ cu. in. per minute.

To check the quantity of air so determined it was not convenient to measure actually the indrawn air after it had escaped from the bubbles, but a relative verification was obtained as follows: the pump-runner when new was 16 in. diameter and its speed was 660 r.p.m. The pump was an ordinary centrifugal, with 4-in. suction and 3-in. delivery, and with an open four-pronged runner. The amount of air drawn in under the conditions of installation, 1-in. suction and 1-in. delivery, was 1000 cu. in. per minute, when new. It was found that the amount became less as the runner-prongs wore down in diameter, in proportion to the square of the peripheral velocity. It was thus calculated that when a pump was only taking 350 cu. in. of air per minute its runner would be only 9½ in. diameter. On removing and opening the pump it was found that the radius of the four prong-tips varied a little, but that their mean diameter was within ¼ in. of that calculated.

A. S. FRY.

Queenstown, Tasmania, November 13, 1921.

Second-Hand Equipment

The Editor:

Sir—In your issue of Nevember 12 you have an editorial on this subject apropos of an address delivered by R. C. Adkinson at Johannesburg. I do not know all that Mr. Adkinson said on that occasion, but I can say that my personal experiences in this connection have been sad. The buying of second-hand machinery is poor business, particularly if not of recent manufacture. Under the most favorable circumstances it is a dangerous procedure.

Old and badly worn equipment that is out of date may be rehabilitated by the owner and put into condition so that it will render long, useful, and profitable service, but the buying of such equipment is another story, for it is expected that, when ready to run, it will earn something. In buying new equipment from a reputable manufacturer you have every assurance that this will be the case, but with second-hand equipment you have no such assurance, for after it is in operation, weakness and worn parts may develop that could not have been noticed without an actual trial, and even then they might not be evident. The cost of overhauling this machinery then falls on the purchaser. This is an added expense, dependent on the seriousness of the defects. There is also the loss of time and production to be considered—a most serious item.

I have spent much of the last 25 years in the mechanical departments of large mining companies and have had to overhaul a great deal of used equipment that was already on hand. Some jobs called for an almost complete re-building of the machines. Many new parts were made and almost all the parts were re-machined. This proved profitable and successful because the company already owned the machinery; it stood on expensive foundations, and in buildings in which extensive alterations would be needed in order to put in new equipment to replace it. The loss of time was less than would have been the case had new machinery been purchased for this purpose.

It has been my experience during a number of years, and particularly during the War, when I was forced to buy second-hand machinery when new equipment was not available for delivery, that new equipment is preferable.

In one case a large second-hand punching-and-shearing machine was purchased when I was master-mechanic for the Consolidated Arizona Smelting Co., at Humboldt, Arizona. The machine was installed properly, but within two or three weeks trouble developed; this was caused by worn parts. For almost a month this machine was out of commission and undergoing repairs; so far as I know it was never in perfect working condition. Another incident occurred later at the same place, with a large lathe bought from the same firm. Trouble with the gears in the apron and the lead screw-nut developed within a few days after starting; and we spent about $200 and much labor to correct the trouble. A milling machine at the same place and bought from a responsible Philadelphia firm gave us more of the same experience.

Shortly after this I went to Cananea as master-mechanic for the Cananea Consolidated Copper Co., and we purchased a large milling machine from a well-known New York dealer. We had similar experiences with this machine. Very likely the sellers of this machinery would pay for the repairs that are necessary. I remember that the firm from which we bought the punching machine did make a liberal allowance to the Consolidated Arizona Co. We were buying considerable quantities of material from them.

In the case of the equipment used at Cananea no refund was made from the seller. We were in both places producing at top-notch speed, trying to maintain production and even to increase it. In order to do so our equipment needed repair, and we were also making additions and alterations that necessitated the machine tools. The delays due to faulty second-hand equipment were aggravating and costly. The cost of the repairs was a small item as compared with the loss of time. The faults could not have been discovered by the seller without actually operating the machines; the trouble could not have been avoided without sending them to the original builders for a complete overhauling.

The safest way is to buy new equipment in the first place. Mine equipment gets much rougher handling and less care from operators who are not mechanics than do machine tools in the hands of experienced machinists. The need for buying new mine equipment is therefore much greater. The manager has enough trouble in regular operation without courting more by trying to save money by buying second-hand machinery. A piece of old equipment may be working well in its original setting, but when it is taken up and put on a new setting it is impossible to give it the same alignment. This will cause trouble; complete safety may be secured only by a complete overhaul and by putting it into the same condition it was in as when originally installed. This is particularly true of such machines as engines, blowers, compressors, and hoists, which are not absolutely rigid by themselves.

Buying second-hand machinery is a matter that will stand a lot of qualifying, but as a general proposition it is not profitable or a money-saver and adds one more element of chance.

J. A. THOMAS.

Los Angeles, February 10.

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*'E. & M. J.', Dec. 22, 1904, p. 280.

WASHINGTON UNIVERSITY, ST. LOUIS

Arthur Thacher, Mining Engineer

An Interview, by T. A. Rickard

Mr. Thacher, you are a New Englander by birth?

Yes, I was born at Newtonville, Massachusetts, in 1857.

Was your father interested in mining or in engineering?

No, he was a merchant.

What was your early education?

In private schools in New York City, and then the School of Mines, in Columbia University, from which I graduated in 1877.

What induced you to go into mining engineering?

It was through friends, such as James E. Mills, the geologist, who made the report on Mine La Motte, W. H. Radford, of San Francisco, whom you know, and Bayard T. Putnam, who worked with Pumpelly.

Were these in your class at Columbia?

Putnam was two years ahead of me, but Radford was in my class. When I started I was not sure what I wanted; so I entered for Civil Engineering, but Dr. Chandler suggested that I add Mining, because the course was better. Afterward, finding the mining course more attractive, and becoming more interested in it, I went through with it, although I took the two degrees.

This explains how you took to mining engineering, but what made you think of engineering in the first instance?

When at school I was quick in mental arithmetic, and my teachers thought that I was going to make a mathematician, so they recommended engineering, but when I got into Columbia under Van Amringe, I soon found that I was no mathematician.

As you know, I have known a great many Columbia men, especially in my early days in Colorado, and I was puzzled for a while to account for their general high level of success in their profession until I made up my mind that it was due to the severe course in mathematics under Van Amringe; in other words, the song "Do ye ken Van Am?" expresses a tradition of which Columbia may well be proud. What do you think?

There is no doubt that Van Amringe did leave a great impress on all the students, but he was ably seconded by others of the faculty, and while their scientific work may not have been anything remarkable they did give to the students a broad view of the engineer and of his work.

Having graduated, how did you get your first job?

A friend of my father's, Charles E. Tilton of Ladd & Tilton, bankers, at Portland, Oregon, was in New York in the fall of 1877 and strongly urged that my place was out West. Therefore I accompanied him to San Francisco in December of that year.

What sort of a town was San Francisco then?

San Francisco was just getting over the boom days of the Comstock, and everybody was interested in mining; even the waitresses were looking for tips on mining stocks.

Did you have any trouble in getting to work?

No, thanks to Mr. Tilton's introductions, there was not much trouble in securing a job, although I had to wait a few weeks. I then accepted work for Mr. Brooks, who was operating the Progreso mine, at Triunfo, in Baja California. They were using the old hyposulphite leaching process.

You went there as assayer and surveyor?

I went there to assist in the assaying, but before long I had the surveying and, later still, charge of the refinery.

How long did you stay there?

I remained there about a year. The place was isolated, and I became restless to go elsewhere, so I went to Arizona, arriving there during the boom days of Tombstone.

To what place did you go in Arizona?

I went to Arivaca and Oro Blanco, about 60 miles south of Tucson. There was a good deal of mining and prospecting going on, and for the next few years I was engaged in assaying, prospecting, and contracting work.

Those were the days of Indian troubles; did you ever come in contact with them unpleasantly?

Personally I never had any such experience, but the Indians were out frequently on their raids and a number of my acquaintances were killed.

Do you recall any members of the profession you met at that time?

W. A. Hooker visited Arizona at that time, John A. Church was operating at Tombstone; Charles W. Goodale and William P. Blake were thereabouts.

So you had a pretty good local practice?

Yes.

How did they pay in those days?

Professional work was not well paid, and what we made on contracting work we usually blew into prospecting, so we just about kept even.

What did you do next?

In 1883 I went back to New York and opened an office there. For the next few years I was doing consulting work. In 1885 I went to the Viola mine in Idaho, where a class-mate, Ralph Nichols, was in charge, and spent a year or more with him as his assistant. The deposit was one of those large masses of lead carbonate; the furnaces were erected during my stay, and we had good practice in the mining and smelting of lead ores.

You still retained your headquarters in New York?

I went back to New York in December 1886. William B. Potter, who had just lost his father, Bishop Horatio Potter, was looking for somebody to help him in his professional work in St. Louis, and in January 1887 I joined him on the recommendation of W. A. Hooker, who was a class-mate of Professor Potter at the Columbia School of Mines, class of '71.

Potter was Professor of Mining in Washington University, was he not?

Mining and Metallurgy. Soon after reaching St. Louis he was called away and I had to take his classes and lectures for him. This was entirely unexpected and an altogether new experience for me.

You found it helped you?

It was as good as a post-graduate course, for I soon found the students were further advanced in some of their studies than I was, and I had to sit up nights to keep ahead of them. Sometimes I worked until one or two in the morning so as to be prepared for my students.

What was your title?

I was Adjunct Professor of Metallurgy, and continued to do the work until they abolished the Mining course at the University in 1891.

Meanwhile, you had been assisting Potter in his professional work?

Yes, in the State of Missouri, and also farther west. At that time Prof. Potter was in charge of Iron Mountain and of some other operations near St. Louis.

When your work as professor ceased, did you remain with Potter?

Yes, I remained with him. Shortly afterward I accepted a position with the Central Lead Company in south-eastern Missouri. I had charge of the operations, and later was made president and general manager, until the property was sold to the Guggenheims in the spring of 1905. It now belongs to the Federal Lead Company.

So, during this period you probably had your first contact with large-scale mining operations?

Yes, this was a splendid education for me, as we had concentrating mills and furnaces, and it also gave me an insight into labor conditions. Fortunately, we had an excellent board of directors, and they supported my efforts.

Among your labor experiences, did you have a strike?

Yes, we had a serious strike during the winter of 1903-'04. It involved not only the miners' union, but about ten of the other labor-unions in the district, including the building trades. Gompers, Moyer, and Mitchell all took a hand in the strike.

Well, you have had similar experiences since, I presume, and you probably have a definite notion as to the best way to settle the industrial conflict? Do you believe in collective bargaining?

No, I do not believe in collective bargaining, as it is generally understood. I believe in full co-operation with your own workmen and permitting them to have a good deal to say about the conditions under which they work, but without interfering in the management of the property.

Please go ahead and state your ideas as to the best way for decreasing the friction between employer and employee.

The friction will never be decreased until the management endeavors sincerely to help the working-men, not from a selfish motive, but in the realization that the men are human beings. The management must learn that success can come only from a close co-operation in the work. Anything that helps the workmen helps the whole operation. In the past we have been under the impression that we must have autocracy or slave-driving, and that the function of the management was to look for defects. If we reverse this and really try to help the men, if we look for what good there is in them, and for what they are doing well, we can get much better results. I do not believe that the world is moved primarily by the dollar sign and the selfish motive: I believe that the paramount motive is the desire for achievement, and under proper stimulus this can be developed for the good of all concerned.

You think that this applies to the uneducated as well as to the educated?

I believe this applies even more to the uneducated than to the educated. They are quicker in discerning selfish motives and they will respond quicker to kindness and the square deal. You can more easily deceive your board of directors and the public than you can your men, and if you really do not believe in the men it is hopeless to expect that you can by any words make them think that you do, or conceal any selfish reason you have for trying to urge them on. This can be illustrated even with the animals, for a dog recognizes his friend and detects his enemy. The idea of achievement as the controlling motive can also be illustrated by the child who will spend time in trying to build his blocks a little higher, simply for the desire of creating something new.

Then you think that this dominant desire is inconsistent with collective bargaining as conducted by unions?

Yes, our present system of unionization is not founded on true representation. Collective bargaining has a tendency more to pull down to the lower level of efficiency than to encourage the men to greater effort.

But the employers are unionized; capital generally acts in unison?

True, and I do not object to the employees being unionized, but only to the present system, which does not give true representative control.

How would you improve it?

The men should do away with their present system of voting, and adopt the secret ballot, and thereby obtain a true system of representation instead of a dictatorship.

What made you leave the Central Lead Company?

The sale of the property to the Guggenheims in 1905. For the next year and a half I was doing consulting work for the Guggenheims and others, and then went with the New Jersey Zinc Company. Back in 1890 I did some work for this company at Joplin, and not being able to remain with them at that time, I suggested Pope Yeatman in my place, and he took up the work. After Yeatman's return from South Africa, when the New Jersey Zinc Company was taking up Western work, they retained Yeatman as their Western engineer, and on his giving up the appointment in 1906, he suggested that they retain me.

What sort of work did you do for the New Jersey Zinc Company?

The principal work was the development and operation of the Wisconsin mines, although we also developed mines in Colorado and Nevada, New Mexico and Arizona, and did some work in old Mexico, before the Revolution.

Did you have any special experience in the Wisconsin zinc region?

Yes, I had an opportunity there to develop some of my ideas in regard to the handling of labor. We had a little group of men that followed me from the Central Lead Company and were thoroughly imbued with the same ideas on the handling of labor, especially B. A. Hoskins, whom I met first in 1879 in Arizona, and with whom I have been associated ever since. Mr. Hoskins was born in Wisconsin in 1849 and got his early mining there and afterward went to the copper mines of Lake Superior, and then to Utah, where he introduced the first hand-jig in Bingham canyon. Later he was at Pioche. He was without a technical education, but he had a wonderful insight into human nature and had the best ideas of the controlling force of the working-men; to his teaching I am indebted for any success I have had with working-

A CHARACTERISTIC SCENE IN THE JOPLIN DISTRICT, MISSOURI men. As an illustration of what we were able to accomplish, I give you the following:

	Number of mines	Tons per day	Tons per man	Earnings per shift	Cost per ton	Tons per day per mine
1908	1	130	2.7	$1.84	$0.68	130
1909	1	143	2.9	1.94	0.67	143
1910	3	611	4.0	2.24	0.56	204
1911	3	1045	4.5	2.42	0.54	348
1912	3	1039	5.2	2.48	0.47	346
1913	3	1242	5.4	2.49	0.46	413
1914	4	1874	5.7	2.51	0.44	468
1915	6	3091	6.9	2.83	0.41	515
1916	6	3919	7.7	3.22	0.41	653
1917	6	3633	7.5	3.47	0.46	605
1918	5	2803	8.0	3.74	0.47	561

We were fortunate in being isolated from labor-union conflicts. Even during the War we were not as much disturbed as other parts of the country, although we lost most of our good men by volunteering and the draft. I think this tabulation of results illustrates the fact that if we pay attention to the handling of the men and really try to help them, they will in turn help us. The results obtained, although they are good, are still not near what they might be. Even the figure of 8 tons per man, I believe, under favorable conditions, could be raised to as high as 20 tons per man, without any increase in the use of machinery. During the period that this table covers there was no noteworthy increase in the use of machinery, the only exception possibly being the drill, which was improved, but it would have made only a fraction of a day's difference in the results, because we had very few drillers—only five in the average mine. In the case of the hand-shovelers, we increased the amount shoveled from 12 or 15 tons to an average of 55 tons per shift, and with high records of over 100 tons per man per shift.

This was all done without any bonus system, or without the use of the contract system?

No; the shovelers were on piece-work, but I do not attribute our success to the piece-work, for in several instances we increased the speed on day's pay even more than we did on the piece-work. The difficulty with piece-work is that whatever scale you first introduce, you start at such a low efficiency that you are having an ever-broadening gap between piece-work and day-work. It is perfectly apparent that you cannot reduce the rate for piece-work without discouraging the men; or what amounts to the same thing; if you increase the day's pay. The difficulty is that you have a widening gap, which can never be successfully bridged and be fair to the men.

What did you do next?

At the present time I am in general consulting work, although still retained as a consultant by the New Jersey Zinc Company.

Mr. Thacher, I am aware that you declined the nomination to the Presidency of the American Institute of Mining & Metallurgical Engineers, but you take a keen interest in its affairs, I know, and I would like to ask you what you consider should be its chief functions?

It seemed best for the Institute that I should decline the nomination at this time, but I believe the Institute is one of the greatest powers that we have for good. It has not commenced to take the place to which it is entitled. We must, however, give the matter careful attention and note the fact that we have not altogether been following the right lines. In our eagerness for representation, which is entirely proper, we now have a condition that gives us a paper representation, which is totally inadequate. While it is very nice to elect a director from an outlying Section, we must realize that as the Institute is an incorporated body, a director cannot act by proxy, or by letter ballot. If he is unable to attend the meetings, we have only the name, not the representation. If we recognize this fact, I think we can, in a large measure, overcome these troubles by letting the Local Sections elect men who may be residing even temporarily in the East and who would be able to attend the meetings and represent their interests. We also have another method of representation, for we find in the constitution of the Institute that the chairman of each Section, or his representative, is invited to all the meetings of the directors, and he receives the minutes of the meetings. It is true, he cannot have a vote, but my own experience on the board was that any representative from the West had more influence with the board of directors than if he had even been a director, for they were inclined to consult local sentiment and be influenced even when they were not enthusiastic about the matter in question. What we really need is that the Sections shall become more consolidated, so that they will take a more unified action in matters that come before the directors.

Do you mean that the chairmen of the various Sections should correspond with the chairmen of the other Sections, so as to elicit local opinion on subjects coming before the board of directors?

Yes. First, let the questions be taken up by the Local Section; then let it get other Sections that are influenced by the same considerations or viewpoint; then if they send on something concrete to the directors, they are sure of getting a good hearing.

Then you believe in decentralization?

Yes, I believe in a true republican organization, in which the individual and the small units shall become more active and attend to their local needs and wishes and requirements, while still retaining the national organization for more limited functions. Just how these can best be worked out is a little difficult to say, but with a frank discussion of all the questions and a knowledge of the facts, I have every confidence that the engineers can work out an acceptable solution of the problem.

Do you believe that the Institute is more effective today with its larger membership than it was when it was a smaller and a more compact organization?

There is no reason why it should not be even more effective with a larger organization, providing that these are proper members, because we can see that in the future we are going to be many times as big as we are now, for the engineering profession is going to grow and take a more prominent part in all public affairs. It is only a question of organization, so that we can develop the real resources of the engineer. We now have something like 10,000 members, but in the future we are going to have double or treble this number, and it is up to us to lay the foundation so that the Institute can operate successfully with the larger membership.

I would like to ask you whether you think, or do not think, that the publishing activities of the Institute are excessive?

This cannot be answered in a few words. Necessarily the mining engineer covers a broad variety of subjects. To satisfy the requirements of the mining engineer we have to publish papers on widely divergent subjects. The only solution seems to me to be that we must classify our publications and have a series of different volumes, letting each member be entitled to one or two of these volumes and pay an additional price, or the cost of printing and paper, for any of the other volumes he may desire. It is true this would largely curtail the efforts of those who wish to complete a set, but we are having such a mass of literature on all subjects that most of us have felt that we could no longer accumulate all of it, and, personally, I have commenced to break my sets and give away volumes in which I am not interested. This happens with our State Geological Surveys, which cover broad fields. Most of us are only interested in one or two of the subjects and we find it utterly impossible to house all the publications that come to us. Thus, in our Institute most of our metal miners are not interested in oil and do not care to receive the papers on oil. We have also many members who take only a mild interest in any of the publications, and they certainly do not wish to be flooded with printed matter.

Do you think that the fundamental purpose of the Institute is to promote the solidarity of the profession and to bring the members together as social gatherings, and of late years to express the considered thought of the profession as a whole, to do these three things, rather than to act as a publisher, a work that is being done fairly well by other agencies already established?

There is a good deal to be said for this view of the case, but there are many papers that it seems necessary for some society to publish. It does not, however, mean that every member of the Society could possibly read all the papers. There are plenty of points of contact on general propositions, of engineering, labor, and so on, where we could all unite, although I fully agree with you that the main thing is to promote personal contact among engineers. It is quite clear you cannot get this adequately at national meetings, so we must develop the sectional meetings.

I forgot to ask you a question on the subject of education. You were a teacher, and you have been a practising engineer; you are, therefore, in a position to have a definite opinion as to the kind of education a mining engineer ought to have?

On the general question of education we may divide the subject into three classes: scientific, artisan, and engineering. In the case of the scientist, he is called upon to deal with natural laws; his training and work do not make him excel in the work of engineering. The artisan is simply learning the manipulation of processes. The mining engineer, I believe, requires an entirely different training. The mining engineer is the pioneer, the builder of civilization; his training must include the study of literature, economics, finance, and all the branches of knowledge that make for civilization. Naturally, he must have the sciences, but more particularly the applied sciences. If we look at the engineer in this light, we shall see that he has a place in the future that is broad, and that he will have a tremendous influence in the world.

Then you believe in a liberal education instead of a mere preparation for a bread and butter dependency?

Certainly; in my own experience, what I have missed more than anything is a classical education.

How would that have helped you as a mining engineer?

The mining engineer, if he is an operating man, must take his position as a leader in the community. He must control mankind, not only in relation to his board of directors and the public, but with the working-men; unless his ideas are broad and he understands humanity and is able to express himself, he cannot be effective.

Then you maintain that a classical education broadens a man's mind?

It certainly does; but more than this, it gives him the power to express his thoughts, either written or spoken. Without this power, no matter what his ideas are, he can make no success.

How about Abraham Lincoln and John Bright?

While Lincoln did not have the opportunities for school education, he was a big enough genius to overcome this defect, and wherever he got his education, we can see the results were simply classical.

Then by 'classical' education you do not mean the learning of Greek or Latin?

Well, I should include Greek and Latin, for most of us have not the genius of a Lincoln to omit this help and succeed.

What do you consider the future holds for mining engineering as a profession?

I think it holds grand possibilities. I think we are just at the start of an era in which the engineer is coming into his own. We must remember that engineers, as we understand them today, were unknown fifty years ago, and that as regards great enterprise in our industry it is the engineer that can be, and from his training is, the best fitted to achieve results.

You have no fear of the exhaustion of our mineral resources or cessation of mining on a large scale?

None whatever; I think we are only in the dawn of our mineral development. Years ago I used to be worried for fear our resources might become exhausted, but it is simply a question today of our being compelled to exploit lower-grade material. The material is in abundance, if we can handle poorer stuff. Of course, this will naturally increase the price, but the price will not prevent the use, for when we carry it to its ultimate consumption, the price of the crude metal usually does not play a part of more than 5% in the cost to the ultimate consumer. For example, an automobile does not carry over a ton of pig-iron, equivalent to two or three tons of ore. If the cost of the finished automobile be a thousand dollars, the difference in the cost of the original pig-iron is immaterial.

What do you mean by that?

Whether the pig-iron is $20 or $40 per ton, it makes very little difference to the cost of the automobile as sold to the user of it.

Meanwhile you realize the continuing and growing demand for metals?

Certainly I do, because if we go back fifty years and look at statistics for the world, we find insignificant figures for all our metals; and if this past fifty years has given us our tremendous growth, what will the next fifty years do? We have nowhere near reached the saturation point of consumption in the civilized countries, and we have more than a billion people that are coming along for consumption as they become civilized. I would add further that my own belief is that large as our present figures are, it will be less than 15 years before these figures for the world will be doubled.

Electrical Hazards

Dead-metal parts of low-tension equipment should be permanently grounded, according to S. E. Whiting who recently read a paper before the National Safety Council. By the dead-metal parts we mean conduit, cable-sheaths, switch-boxes, compensator- and transformer-cases, motor-frames, and switch-board frames. The National Electrical Code calls for the grounding of conduit, but it leaves option on all other dead-metal parts between permanently grounding the parts or effectively insulating them. Following the Code, the electrical-wiring contractor will usually be found to have grounded all of his conduit, but often he fails to ground also his starting-boxes and motor-frames. It is regrettable that the Code supports him in this omission because, so far as experience goes, there have been more low-voltage fatalities from the omission to ground dead-metal parts than from any other cause. The workman has to place his hands on the switch-box to operate it, and he feels at liberty also to touch any motor-frame or cable-sheath or transformer-casing, because the part is evidently not insulated and appears to be harmless. Inside the box or case, however, the live parts may become loose or the insulation may break down, and one side of the line makes contact with the enclosing parts and the case or box becomes charged to line potential. No short-circuit of the line follows to blow the fuse or give other warning of the defect; the equipment continues in operation with its charged case until some workman touches it and completes the circuit.

The danger of exposure to high-tension current is comparatively limited; we are here considering a range from about 2000 volts up to about 100,000 volts. The wiring is insulated on pole-lines or in underground conduits. The transformers, oil-switches, and lightning-arresters are isolated in power-stations or sub-stations or transformer houses. The bulk of exposure is to employees of lighting, power, and railway companies, but only the electrician or master-mechanic is given access to live parts. All men normally exposed to these high-tension hazards are especially trained in electrical work. Prominent engineers who design high-tension stations sometimes give too much weight to the fact that only expert operators will be exposed to the equipment. Specific cases are recalled in which the designer had omitted guards from 13,000-volt bus-compartments, although the bare circuit wiring reached down to floor-level and within a few inches of the aisle where the operator had to walk; where he had allowed his switch blades to stick out when open beyond the barrier walls; where he had placed a grounding terminal at the back of a compartment containing live wires; where he had placed charging-cords for arresters close to live choke-coils; where he had crowded his switches into so narrow an isle that the operator pulling one switch might thrust his elbow into live parts behind him. There is no justification for the designing engineer to create these shock-hazards merely because the equipment is to be isolated and handled only by operators who know the danger and will not get hurt if they are careful. Any man, trained or untrained, is apt to slip or lose his balance. We have no right to omit the enclosing guards from high-tension equipment, thus exposing the operator to a fatal shock if he should slip, any more than we have the right to send men to work overhead on staging without providing handrails. Fortunately many designers are now providing complete mechanical guarding and adequate clearances when the design is planned, but the thoughtless ones have made it difficult for the safety engineer to avoid the shock hazard when he comes along at a later time. The building is sometimes too small to contain the equipment with entire safety.

Large quantities of oil are left underground when wells are abandoned because no means have been determined whereby it is possible to recover more, according to A. W. Ambrose, chief petroleum technologist of the U. S. Bureau of Mines. This failure to effect a greater recovery of the underground oil is due to the exhaustion of the subterranean gas flow, says Mr. Ambrose. The manner in which gas serves as an expulsive medium was recently shown by an experiment. A steel container about three feet long and three inches in diameter was filled with sand, which was then thoroughly saturated with oil. The amount of oil introduced was known by weight and measurement. After the sand had been saturated, gas was forced into the container under a pressure of 200 lb. to the square inch; then a valve at one end was opened and the gas was allowed to escape, bringing with it perhaps 18% of the oil put into the container.

Ventilation and Human Efficiency

By Leonard Hill

*Stuffiness arises from body-heat stagnation and lack of evaporation from the skin and respiratory surfaces, and is due to the warmth, humidity, and stillness of the air. For air to feel fresh it must have a cooling and evaporative power sufficient to keep the skin pleasantly dry and cool; its temperature must be low; it must be reasonably dry and in gentle motion. The movement is of great importance because it prevents stagnation of air that is warmed and made humid by the skin.

In rooms and workshops occupied by men, natural ventilation set up by inside and outside differences of temperature is sufficient to keep the air in a condition so that neither the increase of carbon dioxide nor the diminution of oxygen through respiration has any physiological effect. Carbon dioxide in the air up to 1% has no effect on a resting person, except slightly to deepen his breathing. Increase of carbon dioxide by a few parts per 10,000 above that in outside air has no influence at all. There is normally 5 to 6% of the gas in the deep parts of the lungs, and the physiological regulation of breathing is such as to keep this amount constant. By keeping the percentage low, the ventilation is sufficient to cool the body, to evaporate moisture from it, and to reduce the number of microbes and particles of dust.

To secure proper cooling and evaporative power in warm places, it is often imperative that the ventilation shall be such that there is almost no measurable increase of carbon dioxide. On the other hand, in cold shops such an increase as 12 to 20 parts per 10,000 is of no account. The concentration or partial pressure of oxygen is much lower at the famous Alpine health resorts than it ever becomes in stuffy rooms, a fact that proves that the diminution of oxygen in such rooms is of no importance. There are no organic chemical poisons in exhaled air; the supposition of the existence of such has been negatived by exact experiment. The stuffy air of crowded rooms and workshops is contaminated with microbes explosively exhaled from the respiratory passages in coughing, sneezing, and speaking, and dusted from clothes soiled by skin or excreta. Such microbes disseminate catarrhs and consumption; they cause a great deal of sickness and lost time. The confined air of rooms and workshops is also contaminated with dust. Free silica and lead dusts have a deleterious effect. Other dusts, such as chalk- and coal-dust, and some dusts containing animal or vegetal matter, such as flour or bone-meal, seem relatively harmless; they are not poisonous, but ultimately they produce chronic asthma among those who inhale them. Some people are hypersensitive to dust. It is claimed in the United States that ventilation should be such as to keep dust down to 200,000 of the finer particles (that reach the lungs) per cubic foot, as measured by the Palmer dust-counter. In many workshops and mines the dust particles present number many millions, even hundreds of millions, per cubic foot.

A high cooling-power excites the tone of the muscles and maintains the metabolism of the body. The body is stimulated to maintain its own heat by combustion of food, this increased combustion depending on greater glandular and muscular activity. The fire of life is kept burning brightly. Greater depth of breathing, improved circulation of blood, better appetite, digestion, and absorption of food result, constipation is avoided, and the bowels are kept clean of bacterial poisons owing to the better use of the food, the more active circulation, and the improved muscular tone of their walls. General health and immunity from disease are thus promoted. The breathing of cool air of low humidity results in a greater blood-flow through the respiratory tract and a greater evaporation of fluid. This tends to keep it clean and healthy, and free from infection.

In the first report† of the Committee on the control of atmospheric conditions in hot and deep mines this statement may be found:

If we feel cold or feel hot we put on or discard clothing, or else avoid the cold or hot atmosphere, or we regulate the amount of muscular exertion and the accompanying heat-production in the body. Hence, so long as a man is in a position to take suitable voluntary measures, he is in little danger of harm from heat or cold. He requires no thermometer to tell him whether he is getting too cold or too hot; a feeling of discomfort warns him at once. It is only when he is unable or unwilling to follow the promptings of nature that he runs risk from heat or cold. For instance, there is grave risk to soldiers who have to march in warm and humid air and in uniforms unsuited for warm weather, or to Europeans who deliberately refrain from discarding their thick clothing in warm tropic climates. To miners, however, the risk of actual injury from heat is absent under ordinary conditions. Work in metalliferous mines is often performed in places where the air is so warm and moist that continuous labor would be impossible. The men work for short periods only, and come out as soon as they begin to feel uncomfortable. In this way the work is carried on without risk to safety or health; but it is expensive on account of loss of time.

Further on in the report Dr. J. Haldane discusses the question whether a high wet-bulb temperature is dangerous to health. He says: "I have watched to see if there is any evidence of health being affected by high wet-bulb temperatures, and I could find none; I do not believe

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*Abstracted from Bulletin 205, I. M. M.

†Trans. Inst. Min. Eng., 1920, LVIII, pp. 231-256.

there is any''. I agree with the statement that people can work for short periods in warm humid atmospheres without harm to health, so long as they are exposed to cool air in their leisure hours. If, on the other hand, they go from work to shut-up tenement-dwellings, crowded conveyances, bars, tea-shops, or cinemas, their health is weakened by stagnant air, and the humid warm air of their workplace contributes to this effect.

The Cornish miners have a high death-rate from phthisis and respiratory diseases, and this is attributed largely to the inhalation of silica dust. I think that the pneumonia which destroys so many native workers in South African mines is due to the atmospheric conditions as well as to infection acting on an 'unsalted' race. The death-rate from all causes and from phthisis is considerably higher among those who work in stagnant warm atmospheres than it is with open-air workers. It has been shown recently that with the spinners and weavers of the Fall River district there is a much higher death-rate from phthisis than occurs with those not engaged in the warm moist mills and sheds; the Irish spinners and weavers have a much higher mortality than the English, because the English are a more salted race, having been longer exposed to tuberculosis in cities and factories, and, having become killed or immunized by small infections, grow more resistant to the disease.

There is overwhelming proof that a warm moist climate, such as is in Singapore, is disastrous to the health, vigor, and efficiency of Europeans; the officials there have to take a year's leave every four years to recover. Even the native Malays are of little good as workers, and have a low resistance to disease. Chinese and Indians do all the effective work. Often the wet-bulb temperature is so high that the body cannot be cooled by sweating; a gang of workers in Singapore may be seen standing idle, impelled to be so by natural law. The high cooling and evaporative power of open moving air has a most beneficial effect on the health. Such physical conditions, not the chemical purity of the air, are potent in producing the effect of a holiday spent at the seaside or on the hills; there is an absence of dust and germs coughed and sneezed by carriers of disease. My co-workers and I have proved by a large number of researches on the metabolism of the body, on the production of body-heat in calories per hour, that this is increased notably by exposure to the open air. The warm radiant heat of the sun and the drying power of the air have a great curative effect on diseased parts.

There are two lessons to be learned by employers:

1. That attention to good ventilation and the maintenance of a high standard of cooling and evaporative power will mean less sickness, greater health, and more enjoyment of life.

2. That a cooling power adjusted to the severity of work and the production of heat will enhance human efficiency and output.

The human body regulates its temperature:

1. By varying the blood circulation near the surface of the skin and thus the heat lost by radiation and convection;

2. By varying the output of sweat and consequent loss of heat by evaporation;

3. To a minor degree by varying respiration and evaporation from the respiratory membrane;

4. To a minor degree by taking hot or cold food and drink, and baths;

5. By varying the amount and character of clothes, and so the loss by radiation and convection and evaporation;

6. By exposure to sun and wind, by confinement in still air, and by artificial sources of heat or cold, such as fires, steam-coils, cool surfaces, or fans.

The body thus regulates its heat successfully in all but extreme conditions. It cannot do so in an atmosphere with a wet-bulb temperature approaching closely to or above body-temperature, for both evaporative and convective heat-loss are then too little. In a wind with wet-bulb temperature above body temperature, heat is rapidly gained by the body. A dry hot wind will also heat the body if sweating fail through fatigue, or if the heat be so great and the wind so high that more heat is brought to the skin than the evaporation of sweat can take away. Haldane takes the wet-bulb temperature as the measure of estimating atmospheric conditions suitable for the efficient output of workers. He considers the limit for men resting and lightly clad is 88°F., or 93°F. in a wind of 170 ft. per minute. If active work be done, the figures are 78°F. for still air and 85°F. in air moving 135 ft. per minute. At 80°F., wet-bulb temperature, he says that the work of a miner decreases, and at 85°F. hard work is impossible. He gives 70°F., wet-bulb temperature, as the desirable maximum for spinning-mills and weaving-sheds, and 75°F. as the permissible maximum. J. L. Bruce regards the dew-point as a better guide than the wet-bulb temperature, and fixes 62°F. as the permissible maximum dew-point. With a dry-bulb temperature of 111°F., a wet-bulb temperature of 82°F., and with the dew-point at 66°, hard work could be done; with a dry-bulb temperature of 90°, a wet-bulb temperature of 81°, and with the dew-point at 74.5°, mental and physical work was almost impossible. The convection currents in the open air were greater in the one case than in the other. Chamber experiments and observations in mines cannot be performed in the open air. Radiation from the sun or other source of heat come into play, and may make neither wet-bulb nor dew-point a correct indicator of conditions suitable for man.

I have introduced the kata-thermometer, an instrument to measure the cooling and evaporative power of the air exerted on a surface at approximately body-temperature. The 'kata' is an alcohol thermometer with a bulb about 4 cm. long and 2 cm. diam., and a stem 20 cm. in length, with graduation marks at 100° and 95°F. The bulb is heated to above 100°F. in hot water (a thermos flask is convenient), dried, and suspended in air, and the rate of cooling observed, that is, the time in seconds that the meniscus takes to fall from 100° to 95°F. By dividing the time into a factor (determined for each instrument) the rate of cooling of the 'kata' surface at 98.4°F. (35.6°C.) is calculated in millicalories (1/1000 gm. calories) per square centimetre per second. The dry 'kata' cools by radiation and convection; in still air, radiation may effect half the cooling; in wind, it becomes insignificant compared to convective loss. In a chamber at 98.4°F., convective and radiation cooling of the dry 'kata', just as of the human body, cease; above this temperature the dry 'kata' is warmed, not cooled by the air, and the greater the wind the quicker is it warmed. The rate of warming may be measured by first cooling the 'kata', by wetting it and permitting evaporation.

A wet-bulb reading of the 'kata' is taken by surrounding the bulb with a wet muslin glove; this gives the rate of cooling by evaporation, convection, and radiation. The difference between the dry and wet 'kata' readings gives the evaporative rate of cooling. The wet 'kata' ceases to be cooled when the wet-bulb temperature reaches 98.4°F., and is warmed by the air in which the wet bulb is higher than this. Wind greatly increases the cooling of the wet 'kata' when the wet bulb is below 98.4°. In these respects the 'kata' behaves like the sweating man.

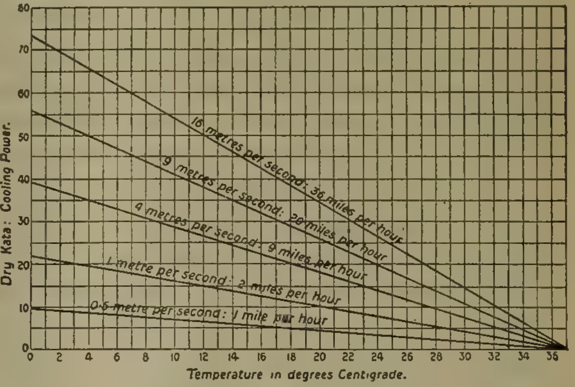
The ordinary thermometer indicates the average temperature of its surroundings; it is not a dynamic instrument producing heat like the human body, and shows nothing as to the cooling-power exerted by the air on the body, which depends chiefly on wind. It is a poor measure of ventilation. This is illustrated by the following readings taken on days when the wet- and dry-bulb temperature readings were approximately the same:

	Temperature		Cooling-power		
	Dry bulb, °F.	Wet bulb, °F.	Dry 'kata', °F.	Wet 'kata', °F.	Evaporative power, °F.
Jan. 9, strong north wind..	38	35	56	91	35
Nov. 17, south-east wind, sunny after frost	38	35	27	55	28
Nov. 2, mist, almost calm	42.	42	13	33	20

It must be noted that the 'kata' gives the cooling and evaporative power of the air, exerted, not on the human body, but on its own surface, which is comparable in size to, say, half a human thumb. The large masses of a man's limbs, head, and trunk have a much smaller surface in proportion to their mass than the 'kata', and cool much less readily. A man, too, is clothed; and clothing halves the heat loss. The influence of clothing can be studied by putting gloves of different materials on the dry and wet 'kata' bulb. I have fixed the standard that the dry 'kata' reading should be kept at not less than 6 and the wet at 18 in rooms and workshops, and advise that the cooling-power should be higher than 6 for severe forms of mechanical work.

By adjusting the cooling-power to the heat production of the worker, sweating can be prevented, and the work done with comfort and ease. The curse of Adam can be removed by the aid of a fan; 2 lb. of sweat per hour can be lost by a man in a hot room, or in a hot tropical climate. In relatively dry hot air the sweat is lost without any visible moisture being seen on the skin, and 1 lb. per hour may be lost without skin or clothes becoming damp; 3 gal. or more of water is drunk per day to counteract the loss by sweating in such a climate. The sweating mechanism may become fatigued, or fail, as a result of sickness; and then the man in such a climate is in imminent danger of heat-stroke. He may be saved from this by a water-spray and fan, by inducing artificial sweating. We do not want to sweat visibly in workshops, and have our clothes made damp. The sweat is an emergency method of cooling. We want to keep the body comfortably cool and dry by cooling wind.

Using my methods, extensive researches have been carried out; these show that the cooling and evaporative powers are frequently beneath the standards I have fixed. The figures obtained show how different are the conditions to which the indoor worker is exposed compared to those of the outdoor worker; the latter, in spite of low wage, has a much higher expectation of life. The effect of windows and artificial ventilation has been studied; the conclusion reached was that extraction fans offer the most effective means of securing movement of the air. I have calculated from the heat output of different workers, and their evaporative loss at rest, that the tailor requires a dry 'kata' cooling-power of 5 to cool him by convection and keep him from increased heat loss by evaporation; a shoe-maker, 7; a man sawing wood, 18. We need not stop any increase of insensible sweating, but we may stop, with advantage, visible sweating and any feeling of heat stagnation and lack of comfortable freshness. At the same time we do not want to produce over-cooling. The adaptation of people to warm or cool surroundings is great; they require to be brought gradually from an enervating over-warm environment and accustomed to one that is fresh and stimulating. Most people detest cool drafts; but consumptives that are used to open-air treatment like them, and dislike closed rooms; it is a matter of custom. So, too, with clothing. Many nowadays over-clothe themselves for fear of catching cold, which is really caught by confinement in stuffy rooms and from microbic infection. This is a lesson that people require to learn; traditional lore now keeps many from acquiring healthy hardiness and from enjoying life.



WIND VELOCITY AND 'KATA' COOLING-POWER

Dr. A. J. Orenstein and H. J. Ireland have used the 'kata' for estimating the effect of atmospheric conditions on output and fatigue. They used two forms of ergometer, one imitating hammer-drilling, which proved troublesome, and the other a hand-driven winch that acted on a band brake. A revolution-counter indicated the number of turns given by the operator, whereas the work done during each revolution was known by the friction on the brake. Native labor was employed. Efficiency, taken at 100 with a dry 'kata' cooling-power of 6, was found to fall to 50 when the cooling-power fell to 1; and, as the result of observations made through a section of the mine, the authors concluded that 21% of output was being lost through inadequate cooling-power of the air. By fanning the ergometer workers when they were in a warm place, a 46% increase of output was obtained on one day and a 32% increase on another. The authors draw attention to the risks of the workers passing from the hot and wet workings to the outside air, which has a high cooling-power.

Dr. H. M. Vernon has investigated the effect of ventilation on output of tin-plate factories. In the factory with a fan effectively cooling the workers the seasonal variation of output was only 3%, whereas at other factories where ventilation was less efficient the output fell off in July and August by 10 to 13%. In a large tube-drawing factory I found clusters of large air-ducts to carry air to cool the men in front of the furnaces. Work was done in comfort, the output was excellent, and industrial unrest was unknown; good management in other respects, no doubt, contributed in part to this. In the recent warm October weather I found that a walk of one mile along the sea-shore in 16 minutes, dressed in ordinary clothes and a sweater, sent the pulse to 150; in bathing costume it rose, under the same circumstances, to 130. In one case the walk was a task; in the other case it was a pleasure. The heart is fatigued by having to send blood to the skin to be cooled by sweating.

I have recently contrived an electrical kata-thermometer, and have also perfected a recording electrical kata-thermometer. The 'kata' is a most convenient and sensitive anemometer, particularly for measuring slight air-currents indoors. It totals not only unidirectional currents but eddies, and is thus superior to any vane anemometer. Miss D. Hargood-Ash and I have done a great deal of work to secure accurate formulae for the dry and wet 'kata'; those we published during the War have now been modified by renewed research in the big wind-tunnels at the National Physical Laboratory and at the East London College. The need for aeroplane experiments prevented us from adequately utilizing these tunnels during the War.

We have, with the help of Dr. H. M. Vernon, investigated low air-velocities, by fastening the 'kata' to a rotating arm, and by allowing for the swirl effect by measuring this on a stationary 'kata' that was passed close by it. The new formulae agree with observations taken at Oxford by Dr. Vernon and in Hampstead by us, at the National Physical Laboratory tunnels and the East London tunnels, and with anemometer readings taken by a cup anemometer at Kew, and with one standardized at the National Physical Laboratory. These formulae I give in various forms. They are final, and I think trustworthy:

DRY 'KATA' STILL-AIR FORMULA

$$H = 0.27\ (\phi - t)$$

Where ϕ = the mean temperature of the range of cooling, that is, 36.5°C., and t = the temperature of the air.

DRY 'KATA' AND WIND FORMULÆ

For wind velocities equal to, or greater than:
1 metre per second.
2.25 miles per hour.
200 ft. per minute.

$$H = (0.13 + 0.47\sqrt{v})\ \ (36.5 - t) \ldots\ldots\ldots \text{(i)}$$

Where H is in millicalories per sec. per sq. cm.
v " " metres per second.
t " " degrees Centigrade.

$$H = (0.072 + 0.17\sqrt{v})\ \ (97.7 - t) \ldots\ldots\ldots \text{(ii)}$$

Where H is in millicalories per sec. per sq. cm.
v " " miles per hour.
t " " degrees Fahrenheit.

$$H = (0.072 + 0.019\sqrt{v})\ \ (97.7 - t) \ldots\ldots \text{(iii)}$$

Where H is in millicalories per sec. per sq. cm.
v " " feet per minute.
t " " degrees Fahrenheit.

For wind velocities equal to or less than:
1 metre per second.
2.25 miles per hour.
200 ft. per minute.

$$H = (0.20 + 0.40\sqrt{v})\ \ (36.5 - t) \ldots\ldots\ldots \text{(iv)}$$

Where H is in millicalories per sec. per sq. cm.
v " " metres per second.
t " " degrees Centigrade.

$$H = (0.11 + 0.15\sqrt{v})\ \ (97.7 - t) \ldots\ldots\ldots \text{(v)}$$

Where H is in millicalories per sec. per sq. cm.
v " " miles per hour.
t " " degrees Fahrenheit.

$$H = (0.11 + 0.016\sqrt{v})\ \ (97.7 - t) \ldots\ldots\ldots \text{(vi)}$$

Where H is in millicalories per sec. per sq. cm.
v " " feet per minute.
t " " degrees Fahrenheit.

WET 'KATA' WIND FORMULÆ

For wind velocities to or greater than:
1 metre per second.
2.25 miles per hour.
200 ft. per minute.

$$H^1 = (0.10 + 1.10\sqrt[3]{v})\ \ (36.5 - t^1) \ldots\ldots\ldots \text{(i)}$$

Where H^1 is in millicalories per sec. per sq. cm.
v " " metres per second.
t^1 " " degrees Centigrade, wet bulb.

$$H^1 = (0.056 + 0.47 \sqrt[3]{v})\ (97.7 - t^1) \ \ldots\ldots \text{(ii)}$$

Where H^1 is in millicalories per sec. per sq. cm.
v " " miles per hour.
t^1 " " degrees Fahrenheit, wet bulb.

$$H^1 = (0.056 + 0.11 \sqrt[3]{v})\ (97.7 - t^1) \ \ldots\ldots \text{(iii)}$$

Where H^1 is in millicalories per sec. per sq. cm.
v " " feet per minute.
t^1 " " degrees Fahrenheit, wet bulb.

For wind velocities equal to or less than:
1 metre per second.
2.25 miles per hour.
200 ft. per minute.

$$H^1 = (0.35 + 0.85 \sqrt[3]{v})\ (36.5 - t^1) \ \ldots\ldots \text{(iv)}$$

Where H^1 is in millicalories per sec. per sq. cm.
v " " metre per second.
t^1 " " degrees Centigrade, wet bulb.

$$H^1 = (0.19 + 0.36 \sqrt[3]{v})\ (97.7 - t^1) \ \ldots\ldots \text{(v)}$$

Where H^1 is in millicalories per sec. per sq. cm.
v " " miles per hour.
t^1 " " degrees Fahrenheit, wet bulb.

$$H^1 = (0.19 + 0.082 \sqrt[3]{v})\ (97.7 - t^1) \ \ldots\ldots \text{(vi)}$$

Where H^1 is in millicalories per sec. per sq. cm.
v " " feet per minute.
t^1 " " degrees Fahrenheit, wet bulb.

THE ELECTRIC 'KATA'. The electric 'kata' is a modified form of the ordinary 'kata', designed to enable the cooling-powers to be read with little more trouble than is an ordinary thermometer. The instrument consists of an ordinary 'kata' bulb, but the stem covers a range of temperature from 25.5° to 44°C., cooling-powers 4 to 9 being marked. Through the bulb is passed a high-resistance wire; and a constant supply of heat is produced by introducing the instrument into an electric circuit and by keeping the current constant. The heat given to the 'kata' per second remains the same and the loss of heat depends upon the difference between the temperature of the bulb ϕ and the air temperature t; so that when t alters, it is evident that ϕ must also alter, and in this way the cooling-power may be determined. The following theory contributed by Miss Hargood-Ash gives the relation between the value of the cooling-power and the electric 'kata' temperature:

For the ordinary 'kata' in still air we have the general formula

$$H = 0.27\ (\phi - t) \qquad \text{(i)}$$

where H is the cooling-power, ϕ the mean temperature of the range of cooling and t the air temperature.

For the ordinary range this is

$$H = 0.27\ (36.5 - t) \qquad \text{(ii)}$$

Now in (i) if the 'kata' could be kept at a temperature of ϕ for a given value of t, the loss of heat per second would still be given by H; this is what is done in the electric 'kata', and therefore (i) may be taken as the equation of the electric 'kata' where ϕ is the temperature-reading of the electric 'kata'. In the electric 'kata' H is fixed; let its value be h, then at any temperature t, we have from (i).

$$h = 0.27\ (\phi - t)$$

or

$$t = \phi - \frac{h}{0.27} \qquad \text{(iii)}$$

substituting this value of t in (ii) we get

$$\begin{aligned} H &= 0.27\ \left(36.5 - \left[\phi - \frac{h}{0.27}\right]\right) \\ &= 0.27\ (36.5 - \phi) + h, \qquad \text{(iv)} \end{aligned}$$

giving a simpler linear relation between H and ϕ, and every value of ϕ has a corresponding value of H.

This formula does not hold when there is a wind, but if the electrical 'kata' is kept at the standard 6 to 7, the error is small.

RECORDING 'KATA'. The recording 'kata' is a modification of the ordinary 'kata', designed so that an automatic record of the cooling-powers may be obtained. The bulb of the instrument has a coil of wire of high-temperature resistance, this coil forming one arm of a Wheatstone bridge. The resistance in the other three arms are so arranged that the bridge is balanced when the 'kata' coil is at a temperature of 36.5°C. The heat required to produce this temperature is supplied by the current flowing through the coil. The value of this current is read on an ammeter in series with the coil; the resistance of the coil being known, the heat production per second is calculated easily; this will, of course, be equal to the loss of heat if the temperature of the bulb remains constant; the current readings may therefore be expressed directly in cooling-powers. An automatic arrangement regulates the current so that a temperature of 36.5°C. is maintained by the bulb, the current being increased when the cooling-power becomes greater and diminished as the cooling-power decreases. The ammeter furnishes the recording part, the needle being caused to mark its position at regular intervals on a paper drawn beneath it at a steady rate. The recording 'kata' allows continuous records to be taken of the cooling-power of the air. Thus the cooling-power at any moment in any part of a mine is available at the manager's office on the surface.

DURING 1921, states a consular report, there were only four shipments of vanadium ore from Peru to the United States, aggregating 44,562 sacks with a total weight of 2362 metric tons, values by the shippers at 12.45 *soles* per sack at the port. In shipments covering the 1921 exports the value has been reduced to American money at two (*soles*) for one (dollar) as in 1920, giving a total of $277,400, despite the fact that Peruvian exchange has been more than 20% below par during the year. The Lima office of the Vanadium Corporation advises that the maximum acid content of the Peruvian product during the past two years has been 26%, the average being 20%.

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*10 'soles' = 1 libra = £1 = $4.86 at normal exchange.

Thermal Requirements of Chloridizing Volatilization

By Harai R. Layng

The subject of heat in relation to chloridizing volatilization has been considered carelessly or evaded by most of the writers or workers interested in the processes. Investigations have taught me that many people have a notion that the consumption of fuel is excessive.

The foundation for such a notion may be the experimental furnace in the Bureau of Mines Experiment Station at Salt Lake City. This furnace has been described to me as a revolving furnace about 20 ft. long, 1 ft. inside diameter at the feed and flue end, and 2 ft. inside diameter at the discharge and fire end. The flue end was 14 ft. long and the fire end 6 ft. long. The temperature at the fire end varied between 800°C. and 1100°C., and the temperature of the gases leaving the furnace varied from 500°C. to 700°C. The flue-gases measured, when 5 gal. of oil was consumed per hour, 450 cu. ft. per minute at 500°C. The feed amounted to 200 lb. of silicious lead (10%) ore per hour. Very little excess air was said to be used. The ore remained in the furnace over half an hour and the dust loss amounted to 12%. The temperature of the ore entering the furnace was about 200°C.

Starting with that information as a basis, I have calculated that the fuel consumed per ton of ore would be equal to 387.5 lb. of 20,000 B.t.u. oil. The products of combustion of one pound of that oil with 25% excess air of 60% relative humidity would amount to 452.28 cu. ft. at 932°F. (500°C.). Assuming that ore from the Tintic district (Utah) was treated, the gas from the ore would amount to only a few cubic feet per minute (most of the lead-chloride gas would be condensed at 500°C.), it is apparent that about 25% excess air was used. Each pound of oil so consumed would result in 19.629 lb. of products of combustion. The calculated specific heat of the products of combustion is 0.2456; therefore the sensible heat in them, over 60°F., at 1300°F. (705°C.) would amount to 5977.8 B.t.u. per pound of oil. The latent heat of the 1.32 lb. of steam from combustion would be 1274.2 B.t.u. per pound of oil. Therefore the heat carried from the furnace would be 7252 B.t.u. per pound of oil or 1435.37 B.t.u per pound of ore, which is equal to 36.26% of 3875 B.t.u., the amount of heat consumed per pound of ore. Assuming the heat required for chemical reactions (excluding latent heat of fusion and evaporation of the chlorides), heating the ore and its chloridizer from 60°F. and consumed as latent heat in the steam formed to be 600 B.t.u. per pound of ore, there would remain 1839.63 B.t.u. per pound of ore to be accounted for as radiation loss and as the latent heat of fusion and evaporation of the various chlorides. The heat distribution of the furnace accordingly would be 36.26% in the products of combustion, 15.48% as useful work, and 48.26% as radiation and latent heat of fusion and evaporation of the chlorides. Radiation depends mainly upon temperature, area, and thickness of the furnace-walls. Consideration of the fact that the radiation in a large revolving lime-kiln operated at the same temperature as the experimental furnace is only 6% of the fuel or 536.2 B.t.u. per hour per square foot of internal area of the furnace-walls, in comparison with the 4409 B.t.u. per square foot per hour of the experimental furnace, would cause doubt as to the possibility of such a great radiation loss and would also lead a person to believe that the latent heat of fusion and evaporation of the chlorides would account for a considerable part of the heat loss tentatively accredited to radiation.

The latent heat of evaporation of the chlorides is a serious factor in the fuel consumption of revolving furnaces, owing to the high temperature of the discharged gases, but it has no effect on my stack furnace, from which the gases are drawn at temperatures far below the condensation temperature of the chloride gases. In the revolving furnace, it is necessary, in order to heat the ore rapidly and gain the benefit consequent thereto, to discharge the gases at a high temperature. I have not found any data on the latent heat of evaporation or fusion of such chlorides as those of sodium, calcium, lead, copper, and gold. Recently it occurred to me that the Bureau of Mines engineers may possibly have determined these latent heats, but they informed me that they had no data on the subject. The same communications advised me that they had not figured on the heat distribution of their revolving kiln. This information was rather a surprise to me, as scientific research such as the determination of specific heats and latent heats of evaporation and fusion of various elements and compounds should be the work for a Government institution rather than experimental engineering work, which latter should more properly devolve upon inventors, practising engineers, and corporations. It may be, however, that the Bureau engineers do not realize the importance of the latent heat of evaporation. They have, however, devoted considerable time to the determination of vapor-pressures of lead and silver.

The latent heat of evaporation has been determined on a number of elements and compounds. There does not appear to be any means of calculating the latent heat of evaporation of a compound, using the latent heat of the elements thereof as a basis; it is possible, however, to approximate the latent heat of evaporation when the vapor-pressure is known. This may be calculated by means of reversing Williamson's formula for calculating vapor-pressure. In the case of some chlorides it appears that the latent heat of evaporation of the chloride is lower than that of the unchloridized element. The latent heat of evaporation of phosphorus is 234 B.t.u., whereas the latent heat of evaporation of phosphorus trichloride is 93.6 B.t.u. The latent heat of evaporation of chlorine is 120.6 B.t.u., of hydrogen it is 221.4, whereas for hydrochloric acid it is 399.6. The latent heat of evaporation of a few of the elements is given hereafter for the purpose of comparison: lead, 811.8; gold, 572.4; silver, 864.0; sulphur, 417.6; mercury, 122.4; zinc, 811.8; and potassium, 1056.6, B.t.u.

I note that the engineers of the Bureau of Mines Experiment Station recommend the addition of 15% limestone to ores that have a tendency to sinter. The addition of that amount of limestone to an ore like the analyzed ore described hereinafter would increase the heat consumption of the ore in the revolving kiln at the rate of 237.9 B.t.u. per pound of ore. In the stack furnace this would be approximately 50% of the heat required per pound of ore.

In my stack furnace the gases are drawn off at below 360°F. The average temperature of the furnace is about 1130°F., whereas the average temperature of the revolving kiln is about 1650°F. The radiation on a 100-ton stack furnace would be about 135.23 B.t.u. per square foot, whereas for a one-ton experimental stack furnace having only 9-in. walls the radiation would be about 270.26 B.t.u. per square foot. Assuming that the oil is burned in 25% excess air of 60% relative humidity, the heat distribution on the analyzed ore and its added chloridizer (the chemical heat requirements of which are 158.7 B.t.u. per pound) would be, for the 100-ton stack furnace, 13.76% in the products of combustion, 5% radiation, and 81.24% work, whereas, on the one-ton experimental stack furnace it would be 18.76% in the products of combustion, 29.5% radiation, and 51.74% work. In the 100-ton furnace one pound of oil would treat 34.27 lb. of ore, whereas it would treat only about 21.8 lb. of ore in the one-ton experimental stack furnace. The fuel consumed in the experimental revolving kiln is equal to about 5.16 lb. of ore per pound of oil. The foregoing figures demonstrate clearly the effect of radiation and latent heat of evaporation. They also show, relative to fuel consumption, the advantage of the stack furnace over the revolving furnace, and the disadvantage of a small furnace. The calculations that I have made as well as other work and studies that I have done cause me to be firmly convinced that the work on chloridizing volatilization being performed by the Bureau of Mines engineers with the experimental kiln has done and is doing more harm than good to the advancement of the art of chloridizing volatilization.

I have worked out a method for estimating the fuel requirements in my processes, and the results by the method check close enough to the actual fuel consumed to cause it to be a fairly accurate guide in estimating the fuel requirements of an ore. In order to calculate the fuel requirements it is necessary to have a complete analysis of the ore not only as to the elements in the ore but as to the combinations of the elements as they exist in the ore. It is necessary to know the amount of chloridizer required and the temperatures used. The heats of formation are not all known, but they have been sufficiently determined to cause the result of their application to be fairly accurate. The chemical reactions, of course, must be known, otherwise they would have to be assumed.

The following example of the method is given for the purpose of illustration. It may not be strictly accurate, but it is sufficiently accurate for the purpose of illustration. The ore is treated with 1% salt and 5% calcium chloride in the form of a solution of 90% saturation. The fuel-oil is burned in 25% excess of air. The temperature of the flue-gases is figured at 360°F. The temperature of the discharging residues is 1860°F., and the temperature of the feed and air is figured at 60°F. Table I shows the analyses of the ore. Table II shows the analyses of the residues discharged per pound of ore fed. Table III shows the analyses of the gases per pound of ore and its added chloridizer.

I	%
H_2O	1.0646
SiO_2	82.3400
$PbSO_4$	0.7174
$PbCO_3$	1.0189
$CaSO_4$	1.2601
$CaCO_3$	5.5918
$MgCO_3$	2.9979
$CuCO_3Cu(OH)_2$	0.8350
MnO_2	0.1500
NaCl	0.2400
Fe_2O_3	3.7500
	99.9657
Ag	5.07 oz.
Au	0.06 oz.
Hg	Trace
Calculated specific heat	0.1927

II	lb.
SiO_2	0.823400
$CaSO_4$	0.012601
CaO	0.031313
MgO	0.014330
MnO_2	0.001500
Fe_2O_3	0.037500
*Na_2O	0.006020
†CaO	0.019045
	0.946291
Specific heat	0.1690

III	lb.
H_2O	0.05851
CO_2	0.03426
$PbCl_2$	0.01745
$CuCl_2$	0.01018
HCl	0.01458
Cl	0.00756
	0.14254
Specific heat	0.2822

*Includes Na_2O from the chloridizer and is probably combined with silica.
†CaO from chloridizer.

0.00481 lb. Cu requires	0.0112	lb. $CaCl_2 2H_2O$
0.0049 lb. Pb in $PbSO_4$ requires	0.00348	" "
0.0081 lb. Pb in $PbCC_3$ requires	0.00571	" "

0.02039 lb. $CaCl_2 2H_2O$ deducted from 0.05 lb.=0.02941 lb. $CaCl_2 2H_2O$ excess chloridizer.

	Heat equivalent	
0.00348 lb. $CaCl_2 2H_2O+PbSO_4{}^{*}=PbCl_2+CaSO_4+H_2O=$		−0.169
0.00571 lb. $CaCl_2 2H_2O$+heat$=CaO+2HCl$; $2HCl+PbCO_3=PbCl_2+CO_2+H_2O=$	+2.449	
0.0112 lb. $CaCl_2 2H_2O$+heat$=CaO+2HCl$; $4HCl+2CuO$†$=2CuCl_2+2H_2O=$	+2.159	
0.02941 lb. $CaCl_2 2H_2O$+heat$=CaO+2HCl$‡$=$		−4.958
0.01244 lb. $2NaCl+SiO_2+O=Na_2OSiO_2+2Cl$¶$=$		−5.264
0.055918 lb. $CaCO_3$+heat$=CaO+CO_2=$		−41.618
0.02997 lb. $MgCO_3$+heat$=MgO+CO_2$=assumed $MgCO_3$ at 270,600=		−20.936
	+4.608	−72.945

*This reaction would take place when solution meets ore either at top of the furnace or before entering furnace.
†No data available on $CuCO_3Cu(OH)_2$, so CuO figured.
‡In the absence of water vapor some chlorine is formed instead of HCl.
¶In the presence of water vapor HCl is formed instead of Cl.

72.945–4.608=68.346×9/5=..123.02 B.t.u. per lb. of ore, chemical heat
0.01074 lb. H_2O at 966 =.... 10.37 " " " " latent heat of steam
0.0262 lb. H_2O water of solution of $CaCl_2 2H_2O$=....... 25.31 " " " " " " " "

Chemical heat (latent heat) .158.70 B.t.u. per lb. of ore and its chloridizers

	B.t.u. per lb. of ore
Sensible heat discharged in residue = 0.946291 lb. at 0.169 heated 1800° =	303.98
Sensible heat discharged in gases = 0.14254 lb. at 0.2822 heated 300° =	12.06
Chemical heat =	158.70
Total heat required for ore and chloridizer =	474.74

1 lb. of 20,000 B.t.u. oil burned in 25% excess air of 60% relative hu-

midity will form 19.5 lb. products of combustion at a specific heat of 0.2454.

	B.t.u. per lb. of oil
19.5 lb. products of combustion at 0.2454 discharged at 360°F. =	1458.99
1.32 lb. steam from combustion + 0.1295 lb. vapor in air = ...	1293.78[*]
Radiation loss 135.23 B.t.u. per square foot per hour = 5% = ..	1000.00[†]
Heat consumed in combustion, products of combustion and radiation = ...	3752.77

[*] Includes latent heat of steam and sensible heat.

[†] Calculated for 100-ton furnace.

20,000 − 3752.77 = 15,247 B.t.u. per pound of oil available for work.
15,247 ÷ 474.74 = 34.27 lb. of ore per pound of oil.
20,000 ÷ 34.27 = 583.6 B.t.u. fuel requirement per pound of ore.

The fuel consumed would therefore be about 58.3 lb. of 20,000 B.t.u. oil per ton of ore. As it is not necessary to use 25% excess air there is a margin for safety in the above figures and as approximately 52% of the heat consumed is discharged as sensible heat in the residues a great part of it could be recovered by utilizing it to pre-heat the air for combustion, thereby greatly decreasing the fuel consumption. Comparison of the above figures with those for limestone will be indicative of the low fuel consumption to be expected in practice with chloridizing volatilization.

	B.t.u. per lb.
The heat of formation of $CaCO_3$ = ...	1337.50
The sensible heat of 0.56 lb. of CaO discharged at 1860°F. = ...	220.73
The sensible heat of 0.44 lb. of CO_2 discharged at 1300°F. = ...	118.14
Total heat required (excluding radiation, combustion, and products of combustion loss), $CaCO_3$ = ...	1676.37

The heat required per pound of limestone is 3.32 times the amount required for chloridizing volatilization of the ore shown. In practice in revolving kilns the limestone is burned at a fuel consumption amounting to about 10% of coal, whereas, in large stack furnaces the fuel consumption is about 8 to 8½% coke and the efficiency of the stack furnace is about 96% of the theory. The stack furnace has less radiation and less loss in sensible heat of products of combustion than the revolving furnace. Records have shown that the fuel consumed by the old Stedefeldt furnaces during chloridizing roasting amounted to less than the equivalent of 2½ to 3% of coal per ton of ore.

The specific heats used herein are not strictly correct because many of them have not been determined for the temperatures used. The latent heat of fusion and evaporation of the chlorides would have to be added to the fuel requirements shown by the method cited when attempting to calculate the fuel required for revolving furnaces or other furnaces wherefrom the gases are discharged at temperatures above the temperatures of condensation of the chlorides.

Uranium

[*]The element uranium belongs to that rare but extremely useful group of metals of which tungsten, molybdenum, and vanadium are perhaps the best known. Only in comparatively recent years have these elements found extensive use; their former employment was restricted to the use of a few of their compounds as laboratory reagents, and a small number of minor uses. As for uranium itself, it remained little more than a chemical curiosity until it suddenly came into the limelight by the discovery of its radio-active properties, and its relation to radium and helium. This discovery, although profoundly influencing the conceptions of the atom and the theories regarding the earth's internal heat, is a phase of the properties of uranium which has been adequately dealt with in technical literature during recent years. It is now a well-known fact that given the presence of uranium in an ore, radium will also be present in a certain ratio of the uranium content, the degree of radioactivity is thus not only a guide to the radium content, but likewise to that of the uranium.

With regard to the physical and chemical properties of uranium, it is a lustrous silver-white metal with an atomic weight of approximately 239. It is thus the heaviest of all known elements. The density of uranium is 18.7, which is only exceeded by densities of gold, platinum, and the other metals of the platinum group. Uranium metal melts at about 1800°C., but although the melting-point considerably exceeds that of iron, uranium is much more volatile at high temperatures.

The metal is unattacked by air at ordinary temperatures, but burns brilliantly in air at a temperature of 170°C., and emits copious sparks when struck with a hard substance. This latter property has given it a limited application for making automatic lighters. The metal decomposes in boiling water, forming the hydrated oxide, and it also dissolves freely in most mineral acids and in a few organic acids to form salts of the metal; the best known salts are the nitrate and acetate used as laboratory reagents. The salts are remarkable for their fluorescence, and certain of these are used in the dyeing of silk. The oxide is used for making a canary-yellow glass with a green reflex capable of rendering visible objects that are illuminated by ultraviolet rays.

The ores of uranium are found at Joachimsthal in Bohemia, Johanngeorgenstadt in Saxony, in Paradox valley and other parts of Colorado, and in Utah.

Ores of uranium are never abundant, and the uranium content of such ores rarely exceeds 2 or 3%. The ore minerals are practically restricted to three, namely, pitchblende, which is an amorphous mineral containing uranous and uranic oxides associated with a number of other metallic oxides; uraninite, which is a crystalline variety of pitchblende; these are both primary minerals and usually occur as constituents of veins with an exceedingly complex mineralization genetically connected with granite or pegmatite intrusive rocks. Sometimes the minerals are found as disseminations through, or impregnations in, the igneous rocks. Another important uranium ore mineral, which is also an ore of vanadium, is carnotite. This is essentially a hydrous potassium uranium vanadate; it is considered to be secondary, and it is found in belts in porous sedimentary rocks.

Many parts of the world have never been explored for uranium minerals, and other parts only incompletely. Most of the United States deposits have been discovered during the last few years, and only recently, reports have shown the presence of uranium minerals in abundance in the richly mineralized Katanga region of the Belgian Congo.

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[*] Abstracted from 'Engineering'.

Dividends From Mines, United States and Canada

UNITED STATES

Company and situation	Metal	Shares issued	Par value	Paid from July 1, 1921, to Jan. 1, 1922	Total	*Latest dividends	
						Date	Per share
Ahmeek, Michigan	copper	200,000	$25.00	....	$12,150,000	Sept. 30, 1920	$0.50
Alaska Treadwell, Alaska	gold	200,000	25.00	....	15,785,000	May 29, 1916	0.50
Allouez, Michigan	copper	100,000	25.00	....	2,850,000	Mch. 31, 1919	1.00
American S. & R., U. S. and Mex.	c.l.g.s.z.	609,980 (com.)	100.00	....	46,465,578	Mch. 15, 1921	1.00
		500,000 (pfd.)	100.00	1,750,000	75,796,386	Dec. 1, 1921	1.75
Am. Z. L. & S., Missouri and Tenn.	c.l.z.s.g.	193,120 (com.)	25.00	....	....	....	...
		96,560 (pfd.)	25.00	....	5,903,300	Nov. 1920	1.50
Anaconda, Montana	c.z.s.g.	2,331,250	50.00	....	175,938,250	Nov. 1920	1.00
Argonaut, California	gold	200,000	5.00	....	1,980,000	Mch. 20, 1920	0.05
Atolia, California	tungsten	100,000	1.00	....	5,264,500	Dec. 14, 1918	0.50
Arizona, Arizona	copper	1,519,896	5s.	....	2,713,728	Aug. 31, 1919	0.18
		£316,530 7% pfd.	...	....	£4,637,894	May 31, 1920	9d.
Arizona Commercial, Arizona	c.g.s	265,000	5.00	....	1,086,500	Oct. 18, 1918	0.50
Barnes-King, Montana	gold	400,000	5.00	....	440,000	July 31, 1920	0.05
Bingham Mines, Utah	l.s.g.	150,000	10.00	....	675,000	Sept. 30, 1919	0.25
Bunker Hill & Sullivan, Idaho	l.s.	327,000	10.00	490,500	26,174,250	Jan. 4, 1922	0.25
Butte & Superior, Montana	z.s.l.	290,184	10.00	....	16,940,257	Sept. 1917	1.25
Butte Copper & Zinc, Montana	z.s.l.mn.	600,000	5.00	....	300,000	July 1918	0.50
Caledonia, Idaho	l.s.	2,605,000	1.00	....	4,308,306	Jan. 5, 1921	0.01
Callahan Zinc-Lead Co., Idaho	z.l.s.	325,000	10.00	....	7,721,688	Dec. 30, 1920	0.50
Calumet & Arizona, Arizona	copper	642,521	10.00	642,521	46,915,513	Dec. 19, 1921	0.50
Calumet & Hecla, Michigan	copper	100,000	25.00	....	152,250,000	June 30, 1920	5.00
Cardiff, Utah	l.s.	500,000	1.00	....	875,000	Dec. 20, 1920	0.15
Centennial, Michigan	copper	90,000	25.00	....	360,000	Dec. 31, 1918	1.00
Cerro Gordo, California	l.z.s.	1,000,000	1.00	....	300,000	Jan. 15, 1918	0.05
Champion, Michigan	copper	100,000	25.00	....	25,850,261	Apr. 15, 1920	6.00
Chief Con., Utah	l.z.s.g.c.	884,232	1.00	88,402	2,048,323	Nov. 1, 1921	0.50
Chino, New Mexico	copper	869,980	5.00	....	29,991,709	Sept. 29, 1920	0.37½
Columbus-Rexall, Utah	c.s.g.	586,234	1.00	....	14,656	Dec. 30, 1918	0.02½
Con. Arizona Smelting, Arizona	c.g.s.	1,663,000	5.00	....	498,900	Dec. 17, 1918	0.10
Copper Range, Michigan	copper	395,000	25.00	....	26,998,345	Sept. 15, 1920	0.50
Cresson, Colorado	gold	1,220,000	1.00	....	8,857,162	Jan. 10, 1922	0.10
Daly, Utah	l.s.g.	150,000	20.00	....	3,142,500	July 1, 1920	0.10
Daly West, Utah	s.l.	250,000	20.00	....	6,868,000	Dec. 1, 1920	0.25
Davis-Daly, Montana	copper	600,000	10.00	....	900,000	Mch. 30, 1920	0.25
Dragon Con., Utah	c.l.s.g	1,875,000	1.00	....	206,250	April 25, 1920	0.01
Ducktown, Tennessee	copper	198,000	4.80	....	2,678,702	May 1917	0.96
Eagle & Blue Bell, Utah	l.c.z.s.	893,146	1.00	....	1,607,663	Apr. 28, 1921	0.05
East Butte, Montana	copper	421,849	10.00	....	1,676,370	Dec. 31, 1919	0.50
Electric Point, Washington	lead	793,750	1.00	....	444,500	Sept. 15, 1920	0.12
Elkton Con., Colorado	gold	616,884	1.00	....	3,579,460	May 1915	0.02
Empire, Idaho	copper	1,000,000	1.00	....	300,000	June 30, 1918	0.04¾
Engels, California	copper	1,791,926	1.00	....	698,684	Oct. 19, 1918	0.01½
Federal M. & S., Idaho	l.z.s.	pfd. 120,000	100.00	240,000	15,691,100	Dec. 15, 1921	1.00
First National Copper Co., Cal.	copper	600,000	5.00	....	660,000	Feb. 25, 1919	0.15
Gemini, Utah	g.s.c.	5,000	100.00	....	2,490,000	Aug. 1920	6.00
General Development, U. S.	......	120,000	25.00	....	5,033,917	Aug. 20, 1920	0.50
Golden Cycle, Colorado	gold	1,500,000	1.00	60,000	9,630,300	Dec. 10, 1921	0.02
Goldfield Con. Mines, Nevada	gold	3,559,148	10.00	....	29,177,789	Dec. 31, 1919	0.05
Grand Central, Utah	l.s.	600,000	1.00	....	1,830,450	Jan. 1921	0.01
Hecla, Idaho	l.s.	1,000,000	0.25	270,000	9,005,000	Dec. 28, 1921	0.17
Homestake, South Dakota	gold	251,160	100.00	314,050	42,924,664	Dec. 1921	0.25
Inspiration, Arizona	copper	1,181,967	20.00	....	38,983,704	Oct. 1920	1.00
Iron Blossom, Utah	l.s.g.	1,000,000	0.10	25,000	3,300,000	Dec. 20, 1921	0.02½
Iron Cap, Arizona	copper	142,100	10.00	....	1,031,892	Sept. 20, 1920	0.25
Iron Silver, Colorado	silver	500,000	10.00	....	5,350,000	Jan. 1, 1919	0.10
Isle Royale, Michigan	copper	150,000	25.00	....	2,025,000	Aug. 30, 1919	0.50
Jim Butler, Nevada	s.g.	1,718,021	1.00	....	1,151,074	Aug. 1, 1918	0.07
Judge M. & S., Utah	l.z.c.s.g.	480,000	1.00	....	2,550,000	Oct. 1, 1920	0.12½
Kennecott, Alaska	copper	2,786,679	5.00	....	53,502,344	Dec. 20, 1920	0.50
Liberty Bell, Colorado	gold	133,560	5.00	....	2,701,026	June 30, 1920	0.10
Lucky Tiger, Sonora, Mexico	g.s.	715,337	10.00	422,050	8,227,830	Jan. 10, 1922	0.11
Magma, Arizona	copper	240,000	5.00	....	1,680,000	Jan. 6, 1919	0.50
Mass Con., Michigan	copper	100,000	25.00	....	486,585	Aug. 15, 1917	1.00
Miami Copper Co., Arizona	copper	747,114	5.00	747,114	24,444,887	Nov. 15, 1921	0.50

*These figures include dividends payable on or before Jan. 1, 1922.

Abbreviations: g. = gold, s. = silver, c. = copper, l. = lead, z. = zinc, n. = nickel, mn. = manganese.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. This table will be published quarterly. Corrections are invited.

Company and situation	Metal	Shares issued	Par value	Paid from July 1, 1921, to Jan. 1, 1922	Total	Latest dividends	
						Date	Per share
Mohawk, Michigan	copper	100,000	25.00	....	9,675,000	Feb. 21, 1922	1.00
Nevada Con., Nevada	copper	1,999,457	5.00	....	46,768,616	Sept. 30, 1920	0.25
Nevada Packard, Nevada	silver	1,164,492	1.00	....	112,950	April 20, 1919	0.02
Nevada Wonder, Nevada	s.g.	1,500,000	1.00	....	1,549,005	May 21, 1919	0.05
New Cornelia, Arizona	copper	1,800,000	5.00	....	1,350,000	Feb. 20, 1922	0.25
New Idria, California	quicksilver	100,000	5.00	....	2,705,000	Jan. 1, 1919	0.25
New Jersey Zinc, New Jersey	zinc	350,000	100.00	1,680,000	14,560,000	Nov. 10, 1921	2.00
North Butte, Montana	c.s.g.	430,000	15.00	....	14,657,000	Oct. 28, 1918	0.50
North Star, California	gold	250,000	10.00	....	5,612,040	Dec. 31, 1920	0.30
Old Dominion, Arizona	c.s.g.	297,071	25.00	....	14,405,260	Dec. 31, 1918	1.00
Ontario Silver, Utah	s.l.	150,000	100.00	....	14,157,500	Jan. 4, 1919	0.50
Oroville Dredging, California	g.	686,538	£1	....	£454,781	Mch 1921	9d.
Osceola, Michigan	copper	96,150	25.00	....	17,756,375	June 30, 1920	0.50
Phelps Dodge, Ariz., N. Mex., Mex.	c.s.g.	450,000	100.00	450,000	98,546,527	Oct. 1921	1.00
Plymouth Con., California	g.	240,000	£1	....	£156,000	Mch. 1920	12d.
Portland, Colorado	gold	3,000,000	1.00	....	11,692,080	Oct. 20, 1920	0.01½
Quincy, Michigan	copper	110,000	25.00	....	27,002,500	Mch. 29, 1920	1.00
Ray Con., Arizona	copper	1,577,179	10.00	....	25,412,621	Dec. 31, 1920	0.25
Rochester Silver Corp., Nevada	silver	3,750,000	1.00	88,200	176,400	Jan. 20, 1922	0.05
Shannon, Arizona	copper	300,000	10.00	....	1,425,000	Nov. 15, 1917	0.25
Shattuck, Arizona	c.l.s.g.	350,000	10.00	....	7,612,500	Jan. 20, 1920	0.25
Silver King Coalition, Utah	l.s.	1,250,000	5.00	....	15,563,390	Jan. 3, 1922	0.15
Silver King Con., Utah	l.s.c.g.	850,537	1.00	....	1,562,705	April 1, 1918	0.10
St. Joseph Lead, Missouri	lead	1,409,466	10.00	774,679	23,999,576	Dec. 20, 1921	0.25
Success, Idaho	l.s.	1,500,000	1.00	....	795,000	July 1916	0.03
Tamarack & Custer, Idaho	l.s.	1,776,500	1.00	....	590,209	Jan. 1921	0.04
Tennessee Copper, Tennessee	copper and acid	391,498	no par value	....	5,606,250	May 15, 1918	2.00
Tintic Standard, Utah	l.s.	1,174,500	1.00	58,735	1,597,067	Dec. 31, 1921	0.05
Tom Reed, Arizona	gold	909,555	1.00	....	2,946,958	Mch. 20, 1921	0.03
Tonopah-Belmont Dev., Nevada	s.g.	1,500,000	1.00	75,000	10,418,063	Jan. 2, 1922	0.05
Tonopah Extension, Nevada	s.g.	1,282,801	1.00	193,907	2,878,433	Jan. 1, 1922	0.05
Tonopah Mining, Nevada	s.g.	1,000,000	1.00	50,000	15,025,000	Oct. 1921	0.05
United Eastern, Arizona	gold	1,363,000	1.00	408,900	3,952,700	Jan. 1922	0.15
U. S. S. R. & M., U. S., Mexico	l.z.c.s.g.	com. 351,115	50.00	....	15,315,779	Jan. 1921	0.50
		pfd. 486,350	50.00	851,112	26,583,492	Dec. 29, 1921	0.87½
United Verde Copper, Arizona	copper	300,000	no par value	900,000	56,897,000	Dec. 10, 1921	1.50
United Verde Extension, Arizona	copper	1,050,000	0.50	262,500	12,705,000	Dec. 1921	0.25
Utah Apex, Utah	c.l.s.g.	528,200	5.00	....	1,254,475	Nov. 11, 1920	0.25
Utah Con., Utah	c.l.s.g.	300,000	5.00	....	11,775,000	Dec. 24, 1918	0.25
Utah Copper, Utah	copper	1,624,490	10.00	1,624,490	115,570,887	Dec. 31, 1921	0.50
Utah Metal, Utah	l.c.g.s.	691,588	1.00	....	895,734	Dec. 10, 1917	0.30
Vindicator Con., Colorado	gold	1,500,000	1.00	....	3,847,500	Jan. 24, 1920	0.01
Wellington Mines, Colorado	l.z.	1,000,000	1.00	....	2,050,000	Jan. 2, 1919	0.10
West End, Nevada	s.g.	1,788,486	5.00	....	1,520,213	Dec. 17, 1920	0.05
Wolverine, Michigan	copper	60,000	25.00	....	10,350,000	Jan. 2, 1920	0.50
Yellow Pine, Nevada	z.l.	1,000,000	1.00	....	2,593,000	Sept. 30, 1920	0.03
Yukon Gold, Alaska, Cal., Nev.	gold	3,500,000	5.00	....	9,858,110	June 1918	0.02½
CANADA							
Belmont Surf Inlet, British Columbia	g.c.	2,500,000	1.00	....	562,500	Jan. 1, 1920	0.02½
Coniagas, Ontario	silver	800,000	5.00	....	10,840,000	May 1921	0.12½
Con. M. & S., British Columbia	l.c.z.s.g.	419,098	25.00	....	7,099,596	Sept. 1920	0.62½
Crown Reserve, British Columbia	silver	2,000,000	1.00	....	8,300,000	Dec. 30, 1916	0.05
Dome Mines, Ontario	gold	4,000,000	10.00	238,333	2,395,833	Dec. 1921	0.25
Florence, British Columbia	l.s.z.	1,100,000	1.00	....	35,300	April 20, 1919	0.01½
Granby Con. M. S. & P., B. C.	c.g.s.	150,000	100.00	....	10,339,458	May 1, 1919	1.25
Hedley, British Columbia	gold	240,000	10.00	....	156,000	June 30, 1919	0.10
Hollinger, Ontario	gold	4,920,000	5.00	1,722,000	16,558,000	Jan. 28, 1922	0.15
Howe Sound, B. C. and Mexico	copper	1,984,150	1.00	....	1,190,490	Jan. 15, 1921	0.05
International Nickel, Ontario	n.c.	com. 1,673,384	25.00	....	53,113,676	Mch. 1, 1919	1.00
		pfd. 89,126	100.00	267,378	8,555,982	Nov. 1921	1.50
Kerr Lake, Ontario	silver	600,000	4.00	150,000	8,685,000*	Oct. 1921	0.12½
Lake Shore, Ontario	gold	2,000,000	1.00	80,000	400,000	Nov. 10, 1921	0.02
La Rose Mines, Ontario	silver	1,500,000	1.00	....	7,505,509	April 15, 1918	0.02
McKinley-Darragh-Savage, Ontario	silver	2,247,692	1.00	....	5,955,392	Oct. 1920	0.03
McIntyre-Porcupine, Ontario	gold	3,640,283	1.00	364,028	2,722,712	Jan. 2, 1922	0.05
Mining Corp., Ontario	silver	1,660,050	5.00	....	5,498,875†	Sept. 15, 1920	0.12½
Nipissing, Ontario	silver	1,200,000	5.00	360,000	23,280,000	Oct. 20, 1921	0.15
Porcupine Crown, Ontario	silver	2,000,000	1.00	....	840,000	June 1, 1917	0.06
Rambler-Cariboo, British Columbia	l.z.s.	1,750,000	1.00	....	560,000	Feb. 15, 1919	0.01
Standard, British Columbia	l.z.s.	2,000,000	1.00	....	2,700,000	Oct. 15, 1917	0.05
Temiskaming, Ontario	silver	2,500,000	1.00	....	2,159,156	Jan. 31, 1920	0.04
Tough-Oakes, Ontario	gold	531,500	5.00	....	398,625	Jan. 15, 1917	0.12½
Trethewey, Ontario	silver	1,000,000	1.00	....	1,211,999	Jan. 2, 1919	0.05

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*In addition there was a payment of $600,000 made on July 3, 1919, to the Kerr Lake Mines, Ltd., as a return of capital to the stockholders of that company.

†In addition $1,652,260 was paid by individual companies prior to the amalgamation in 1914.

REVIEW OF MINING

PROPOSED SMELTER AT MOJAVE, CALIFORNIA

The Jo Rand Smelting Co. has been incorporated under the laws of the State of California for the purpose of building a modern smelter at Mojave. This announcement should be received with interest by mine-owners, operators, and lessees in Inyo, Kern, and San Bernardino counties, and the adjacent regions in Nevada and Arizona, where there are a great number of properties containing low-grade gold ores, antimonial silver ores, and lead-silver ores, which under present conditions cannot be shipped to the distant reduction plants. Both the Southern Pacific Co. and the Santa Fe Railroad Co. have established commodity rates from sundry shipping points in Arizona, Nevada, and California to Mojave. A revival of mining of low-grade ores in the Calico, Johannesburg, Daggett, Fenner, Oatman, Kingman, Slate Range, Cerro Gordo, Darwin, Big Pine, and other districts is anticipated.

The officers of the Jo Rand Smelting Co. are: Bela Kadish of Los Angeles, president; W. J. Grindle of Los Angeles, vice-president; R. L. Gilmore of Bakersfield, secretary-treasurer; George Bush, of Sacramento, director.

Mr. Kadish was vice-president and executive officer of the Northport Smelting & Refining Co. for many years, and was owner of the Goldfield Sampling Works at Goldfield, Nevada. The main offices will be at Bakersfield, and active construction is to start at once on the plant. The initial units of the plant will have a capacity of 200 tons per day.

OLIVER IRON MINING CO. WILL TEST CONSTITUTIONALITY OF 'OCCUPATION' TAX IN MINNESOTA

Mining companies having holdings in Minnesota will be interested in the suit filed in the District Court at Duluth by the Oliver Iron Mining Co. and thirty others, to restrain the State from collecting more than one million dollars in tonnage taxes for 1921 mining operations, based on the Minnesota tax of 6c. per ton of ore mined. This suit tests the constitutionality of the Minnesota occupation tax.

APPROPRIATION OF $1,580,900 RECOMMENDED FOR U. S. BUREAU OF MINES; $1,325,940 FOR THE GEOLOGICAL SURVEY

For the U. S. Bureau of Mines the Appropriations Committee has recommended the appropriation of $1,580,900, an increase of $106,600 over the current year, but a decrease of $79,565 from the estimates. The detailed appropriations recommended are: investigating mine-accidents, $378,000; operating mine-rescue cars, $211,000; purchase and equipment of mine-rescue cars, $75,000; testing fuel, $136,000; mineral mining investigations, $125,000; petroleum and natural-gas investigations, $135,000; mining experiment stations, $170,000; buildings and grounds, Pittsburgh, $55,000; mining station and mine inspection in Alaska, $35,000; enforcement of the Oil-Leasing Act, $155,000; purchase of land adjoining experiment station, Pittsburgh, $28,000.

For the Geological Survey $1,325,940 is recommended, a decrease of $288,400 from the current appropriation and $395,114 from the estimates. For specific purposes the appropriations are as follows: topographic surveys, $275,000; geologic surveys, $300,000; chemical and physical researches, $40,000; illustrations, $18,280; report of mineral resources, $125,000; investigation of mineral resources of Alaska, $75,000; gauging streams, $180,000; geological maps, $110,000; classifications of lands, $150,000.

WILLIAM E. COLBY DISCUSSES PROPOSED MINING ACT FOR THE SAN FRANCISCO SECTION

At the monthly meeting of the San Francisco section of the A. I. M. & M. E., held on the evening of February 14, William E. Colby, attorney, who has taken a prominent part in a number of recent lawsuits involving the apex law, addressed the members on the proposed revision of the mining law. Mr. Colby clearly analyzed the principal provisions in which important changes are suggested, and explained arguments for and against them. General discussion followed, but no action was taken to pass resolutions respecting the Act. During the business meeting that preceded the address, it was decided to request subscriptions of not less than $1 from the members of the Section, in order that any curtailment of activities might be avoided.

WAGES RAISED BY SEVERAL MINING COMPANIES IN UTAH

On February 14 the Tintic Standard Mining Co., and on February 16 the U. S. Mining & Smelting Co. and the Bingham Mines Co., announced that the wage-scale that existed prior to January 16, but which on that date was cut 50c., would be restored. This will make the pay for miners $4.25 and for shovelers $3.75, the new scale applying at the mines of the companies at both Bingham and Tintic. The entire force of employees, 150 men, at the Eagle & Blue Bell and Victoria mines of the Bingham Mines Co., at Eureka, walked out on February 10. At the same time, employees of the Tintic Standard mine, totaling about 250, petitioned the management for an increase of 50c. per day. The employees, however, continued to work, pending an answer from the management. Wages were cut 50c. per day on January 16, and there was considerable dissatisfaction among the miners as a result; this crystallized in the formal demand for a reinstatement of the old scale. Employees at the Chief Consolidated and Grand Central mines were not affected, as both of these properties are working on the leasing system.

INSPIRATION CONSOLIDATED STARTS FOUR UNITS OF CONCENTRATOR AT MIAMI

Four of the twenty sections of the Inspiration concentrator again are in operation, after nine months idleness. The plant has been kept in excellent shape and there is expectation that more units will be working soon. About 300 men have been employed around the concentrator and machine-shops and about 200 men were added on the date of opening, although many of them came from the mines, where they had been given temporary employment. The company now has about 850 men working in the mines, where development work has been extended materially and where the maximum mill capacity, 18,000 tons per day, readily could be produced. The company's ore-reserves have been increased by finding a body of 2% mixed carbonate and sulphide ore in the new Porphyry shaft, which is now 420 ft. deep and which has gone through about 60 ft. of mineralized ground without reaching the limit of the ore. This same orebody was cut several years ago in the old Barney shaft and 600 ft. distant.

The International smelter, which is under the same management as the Inspiration, is operating two reverberatories, with continuing production of 15,000,000 lb. of blister-copper per month. The third furnace is to be ready about March 15, in order to handle Old Dominion concentrate. Inspiration concentrate is to be handled as produced, and there will be corresponding reduction in the smelting of Miami concentrate. The smelter bullion-stock has been cut from 65,000,000 lb. to 10,000,000.

SUNDRY FACTORS ARE DISTURBING THE COPPER MARKET

Sales of copper so far this month have been distinctly disappointing, for instead of the expected improvement in the price of copper, a sagging tendency has developed, with selling agencies shading prices in order to attract business. This unlooked for change in the copper market is believed due to the announcement by so many companies that preliminary steps have been, or will soon be, taken for a resumption of operations. At the close of 1921, the situation was promising. At that time the available copper surplus was set at 516,000,000 lb., of which 320,000,000 lb. was held by the Copper Export Association, leaving a balance of 196,000,000 lb. available for the domestic market. At the rate of sales during the last quarter of last year it was figured that within four months, without any further expansion in production, the market would have been in a strong statistical position, with the price for the metal several cents above going quotations.

Sales last month were on the whole light when contrasted with previous ones, but this was not unexpected in view of the large purchases made in the last quarter which supplied consumers with copper for January. This month, however, the trade anticipated a resumption of buying, which so far has failed to materialize. This lack of buying is believed to be owing to the fact that consumers have been content to buy from hand to mouth with the belief that with so many mines planning resumption the available supplies would be increased thus preventing any further appreciation in price. One of the leading authorities on copper in this country, in discussing the recent weakness in the market, stated that it had been due to the fact that a loan had been called. This authority added that one of the copper companies had between 8,000,000 and 10,000,000 lb. of copper tied up as collateral for a loan. This loan had been called and it was necessary to sell the metal.

NEW CORPORATION CAPITALIZED AT $7,500,000 IS ORGANIZED TO ABSORB PARK CITY MINING COMPANIES

Plans for the formation of one of the largest mining organizations in Utah have been completed, according to G. W. Lambourne, president of the Judge allied companies of Park City, who has just returned from a six weeks trip East. The new company will be known as the Park City Mining & Smelting Co., organized under the laws of Colorado, with a capitalization of $7,500,000, divided into shares of $5 each. The corporate powers of the company include mining, milling, ore-dressing, smelting, construction, and operation of power-plants and railway lines. The first property to be taken over by the new company is the Daly-West Mining Co.; its stockholders voting unanimously in favor of the proposition at a recent meeting in Denver. A total of 250,000 shares of new stock will be given in exchange for the entire outstanding shares of the Daly-West company. Stockholders of the Judge Mining & Smelting Co. will shortly vote on the proposition of transferring the property of that company to the new organization. Other Park City properties will undoubtedly be taken over by the Park City Mining & Smelting Co. Officers of the new company are: G. W. Lambourne, president, treasurer, and managing director; Moylan C. Fox, vice-president; Oscar N. Friendly, manager; D. C. Murphy, secretary; W. A. Dunn, assistant secretary. Lambourne states that the shares of the new company will be listed on the New York and Boston exchanges.

HOLLINGER CONSOLIDATED LOSES SUIT FOR DAMAGES AGAINST POWER COMPANY

The action brought by the Hollinger Consolidated against the Northern Canada Power Co. for failing to deliver electric power to the mine last winter, in which the plaintiff claimed nealy one million dollars damages, was dismissed by Judge Middleton at Toronto on Febrary 10.

ANNUAL MEETING OF THE INSTITUTE—FEBRUARY 20 TO 23

The 125th annual meeting of the A. I. M. & M. E. took place in New York on February 20, 21, 22, and 23. Sessions of special sections on Mining Methods, Industrial Relations, Safety, Non-Metallic Minerals, and Iron and Steel were on the program in addition to the usual social and entertainment features. The incoming president, Arthur S. Dwight, and the outgoing president, Edwin Ludlow, are caricatured in the accompanying drawing for which we are indebted to Donald M. Liddell.

LEAD BLAST-FURNACES AT EL PASO WILL BE BLOWN-IN

Five lead blast-furnaces will be blown-in immediatly at the El Paso smelter of the A. S. & R. Co. during the next month. Several hundred new men will be required to operate them, bringing the total employees of the plant to about 1000. A contract for smelting the ore of the Erupcion Mining Co. and the Ahumada Lead Co., owners of mines in Chihuahua, Mexico, has been signed. Officials say that it is expected when the lead-furnaces have been put in operation, the copper department will also have resumed, although the date for the opening of the first copper-furnace has not definitely been decided upon. Originally the El Paso smelter was built for smelting lead. When the American Smelting & Refining Co. built its plant at Chihuahua in 1906, however, most of the lead ore from Mexico was handled there and the majority of the furnaces at El Paso were put to smelting copper.

John C. Greenway says that from 200 to 400 tons per day will be shipped from the Erupcion and Ahumada mines as soon as the track is laid. Grading of the roadbed is proceeding rapidly. General Greenway said: "Before we start shipping ore from the Erupcion mines we hope to be able to obtain better shipping-rates from the Mexican railroads in the removal of the $1 per ton bridge-toll at El Paso. This toll amounts to $50 per car of ore and is a discrimination against El Paso industries. Inasmuch as El Paso has always been the most friendly border town to Mexico, I feel certain that the Mexican government will be readily inclined to remove this discrimination."

ARIZONA

Bisbee.—In spite of predictions that the Bisbee district would not feel any effects from the resumption of the smelters at Douglas for several months, activities in local mines are slowly but steadily increasing. Experienced miners are being taken on at the rate of about 150 per month by the Calumet & Arizona company. Expert miners are desired; the underground force is sufficient.

Globe.—The Arizona Commercial Mining Co., one of the important copper producers in this district, announced on February 15 through H. C. Plummer, general manager, that it will resume shipment of ore as soon as the mill of the Old Dominion company is ready to start operations, probably about March 1. The power-house of Arizona Commercial company has been put in operation. About 25 men are working underground. This force will increase gradually. The company will do some development work in addition to extracting ore.

CALIFORNIA

Cecilville.—Development work has been started at the Lone Pine mine in Squaw gulch. The mine has produced considerable gold ore from pockets at the junction of stringers with the main lode. It is proposed to develop the property systematically. John Maxwell and Charles Morgan own the property.——S. Carpenter and E. M. Robertson have started a drift in the gravel bar at the junction of the East and South Forks of the Salmon river, planning to tap the back channel in the South Fork 'run'. They have stopped work at the drift below the wing-dam farther down the South Fork as the bedrock was four feet below their drain and the amount of seepage water was too large to handle, economically, although the bedrock gravel for four feet in depth had a good average gold content.

French Gulch.—Twenty-two men are employed at the Gladstone mine. The mine was re-opened six months ago. Drifts and tunnels have been cleaned out and re-timbered where needed. Ore production has commenced and the mill will start with a few stamps immediately. The Gladstone has a thirty-stamp mill.

Nevada City.—The shaft into the gravel at the old Malikoff mine, in the San Juan Ridge district, is now down 160 ft. The bottom is in gravel, but the present system of mining only contemplates working 10 or 12 ft. of the bedrock. When the gravel was washed by the hydraulic method the entire mass was washed and the bedrock was found to be rich.

Plymouth.—According to Stanley Arnot, engineer for the Plymouth Consolidated Mining Co., 750 miners are now employed in the mines of Amador county. Both the Argonaut and Kennedy mines are operating on a larger scale than for some time heretofore. The Shenandoah mine, a mile north of Plymouth, is being unwatered, and the Moore mine near Jackson, from which the water recently was pumped, is being re-opened by a company for which H. G. Perry is superintendent. At the Plymouth Consolidated 100 miners are at work.

COLORADO

Blackhawk.—The Silver Mountain Mining Co. is in receipt of settlement sheets from the Arkansas Valley smelter giving returns on an 18-ton shipment. The ore ran 0.30 oz. gold, 106.75 oz. silver, 9.35% lead, $144.85 gross per ton. Net proceeds after deducting freight and treatment were $1687.

Breckenridge.—Dredging has continued this winter in the Blue River valley despite low temperatures of 20 to 30°. The dredges are well heated and the sands brought up from beneath the water are washed before they can freeze. Operations this winter are reported to be profitable.——The rich shoot originally opened at 100 ft. in the Warrior's Mark has been opened east of the shaft at the 150-ft. level. The 'pay-streak' is reported 18 in. wide and assays have shown silver content of from 200 to 300 oz. Some 300 sacks of rich ore are piled up for shipment.

Cripple Creek.—The Cresson mine has been idle, due to frozen water-lines, but shipments have been resumed.

The annual report of the Vindicator Consolidated company just issued shows production by the company of 4273 tons during 1921, with gross value of $127,640, and $99,164 net. Lessees produced and shipped 33,184 tons, with a value of $291,254 net, from which the company received in royalties $90,775. Development for the year totaled 7316 ft. The main shaft is now 2100 ft. deep, and work is in progress to connect with the Roosevelt Deep Drainage tunnel at this depth. The total distance of 3000 ft. has been two-thirds covered and will be completed early in March.

Lessees of the Granite Gold Mining Co. have opened rich ore on the Dillon mine. A two-inch streak on the foot-wall samples $25 per pound.——An ore-shoot 70 ft. in length has been opened at the 9th level of the Rose Nicol mine. Samples assay from 2 to 5 oz. gold per ton. The property is producing about 5 cars weekly of milling ore, shipped by lessees.

Eagle.—Al Hansen and Eastern associates have sent out supplies to the Polar Star mine at Fulford and a force is now engaged in preliminary work, preparatory to installation of machinery and mill construction. The mill will be equipped with a ball-mill, concentrating tables, and flotation unit; a compressor has been ordered for the mine. For the present a gasoline engine is used for power.

"I'M OUT OF IT ANYWAY"
"IF THEY ARE GOING TO ROAST ME, I HOPE THEY WILL AT LEAST USE A GOOD MACHINE FOR IT."
ANYWAY THERE MIGHT HAVE BEEN MORE SPEAKERS"
"IT HAS BEEN A HARD YEAR FOR ENGINEERS"

Changing Shifts in New York

Georgetown.—Denver men who have taken a lease on the dumps at the Scepter mine are erecting a small concentrating plant. They will use the same 'secret' process in the plant on Bard creek as is reported to be operating successfully in the Burleigh mill at Silver Plume. The management of the Republican Mines Co., as an inducement to get the mill started, donated use of the mill-site and necessary timber for the buildings. The operation of the plant will be watched with interest by operators of this section.

Lake City.—Organization has been effected of the Silver Keys Mines Development Co. to operate ten claims on Excelsior and Abbott mountains under lease and bond. The properties are partly developed by shaft and tunnel, and silver-lead ore, assaying $38 to $65 per ton, is exposed on the Silver Key. On the Summit claim, assays of 70 oz. silver and 4 oz. gold have been obtained. The main tunnel is to be extended to cut the orebody on the Silver Key at about 225 ft.——The Colorado Consolidated Mines & Power Co. is operating the Black Wonder; it will have a mill in operation early in June.

Morenci.—George J. Stoneman, president, and Mike Hannon, superintendent, of the Stargo Mines, Inc., have returned from New York, where a contract was entered into with Morris Kuhlman, who will advance $129,500 for the building of a mill of 50 tons daily capacity. The company has been shipping silver ore to El Paso from its property, a short distance from Morenci.

Rollinsville.—The Perigo mill and mines have been started by the Stanley brothers, lessees, who have opened a large body of mill-ore.——A shaft is being sunk on the Navensetter property, adjoining the Maryland group. The owner has opened up the extension of the Maryland vein on his Blue Barrow claim, with a streak sampling as high as 13 oz. gold per ton.——Contractor Murray for the Maryland Mining Co. is taking out good ore while extending the Garfield tunnel, samples taken across two feet of vein matter assaying $25 in gold and silver. The company, controlled by H. F. Christenson of Denver, owns 15 patented claims, with two tunnels, a stamp-mill, blacksmith-shop, ore-house, and boarding-house. Negotiations are in progress with an Eastern syndicate to take the property under lease and bond to purchase.

Telluride.—January shipments of concentrates from Telluride totaled 143 cars, 88 from the Smuggler Union, and 55 from the Tomboy plant. This is the best record for many months.

IDAHO

Coeur d'Alene.—Another carload of ore has been shipped by lessees of the Western Union mine. They plan to ship two cars weekly. This is the property on which a rich find was reported recently. The company gets 25% royalty on all smelter returns on ore shipped by lessees.

Engineers from New York will examine the Independence Lead mine, before installing machinery to secure more rapid development, according to H. B. Kingsbury. The strike in the You Like vein, which crosses the Independence, is important; it shows 20 ft. of concentrating ore and 2 ft. of high-grade ore. The Morning vein also crosses the ground lengthwise. The Independence lies between the Morning and the Hunter mines.

MICHIGAN

Houghton.—Copper Range Consolidated is now close to normal in refined-copper production. The present output is at the rate of 36,000,000 lb. per year, which is not far short of the average yearly production in the years prior to the War. Copper Range has been gaining a few men each month, which has been reflected in an increase in production, and this condition no doubt will continue at least until the spring months when the usual exodus to the farms will begin. No important construction work is planned at mines or mill of this company during the present year.

Quincy is in an excellent position to show a sharp reduction in costs when there is a return to normal production, which of course will be governed by improvement in the demand for copper. Notable improvements have been made at mine, mills, and smelter. The new hoist installed a year ago at No. 2 shaft has not been pressed to capacity because of curtailed production, and as a result has not yet demonstrated its actual worth. This also applies to the new furnace at the smelter. The re-grinding equipment at the mills has been instrumental in reducing losses, having saved 2,345,000 lb. of copper in 1920, and will be an important factor in lower costs when all departments are again on a normal basis. The smelter improvements will cut costs considerably, for much manual labor has been replaced with electrically driven apparatus.

Mohawk and Wolverine are practically at capacity production. Mohawk is shipping about 2300 tons of rock daily, while Wolverine is averaging 900. Mohawk has built up an efficient organization and costs have been materially reduced, the mine being on a paying basis. The yield is holding up well in all shafts and the present rate of profit at the prevailing price of copper is close to one cent per pound. At No. 6 shaft, a full program of sinking and drifting is under way, sharing with No. 4 in the biggest output from the four shafts.

Ahmeek, the best of the Calumet & Hecla subsidiaries, is in good condition physically and will be one of the first properties to get back to normal. There has been practically no caving and all shafts will be in readiness for resumption on April 1. The work of replacing the concrete skipway with timber in No. 2 shaft is well under way and will be completed in ample time. The stamp-mill is in good condition and will require only minor repairs.

The annual meeting of Arcadian Consolidated was held at Houghton on February 14. B. F. Bartholemew was elected a director to succeed the late S. T. Everett, the other directors being re-elected. Robert H. Shields was re-elected president and W. F. Miller, secretary-treasurer. Drifting is still proceeding north and south at the 1100-ft. level of the New Baltic shaft, recently reached. Both drifts are in good mineralized ground.

The recent reduction of freight-rates on refined copper to New York, amounting to 33⅓%, restoring the schedules in effect prior to August 26, 1920, means the saving of one-fifth of a cent per pound. The reduction was effective on February 13.

MINNESOTA

Hibbing.—A branch of the Michigan College of Mines Alumni Association has been formed here. The plans were perfected on the occasion of a banquet in honor of F. W. McNair, president of the College. It is stated that there are about 100 graduates of the college on the Mesabi and Cuyuna ranges and in Duluth, and a strong organization will be formed. J. A. McKillican of Hibbing was made temporary chairman.

MONTANA

Jens.—The Butte & Western Mining Co. is developing the Forest Rose group of 58 claims near here. The property was discovered and first worked years ago by David Dunkelberg, who made a good profit from his operations. The Butte & Western company has driven an adit under the old workings and has exposed a wide vein of good ore at a depth of 400 ft. from the outcrop. The adit is being extended through a series of parallel veins. B. V. Alley of Butte is general manager.

NEVADA

Hawthorne.—The Lucky Boy Consolidated Mines Co. has resumed operations at the old mine, six miles west of Hawthorne on the old Bodie grade. Lucky Boy was discovered in 1905 when several men, repairing the railroad grade, found a small vein of galena. An option was obtained by J. H. Miller and J. E. Adams and men were immediately put to work. In its earlier years the mine produced a million dollars down to the 900-ft. level. The ore averaged 200 oz. silver and 17% lead per ton. Within the last few weeks, in sinking from the 1100-ft. level, four orebodies have been opened up, the ore of which is reported to average $30 per ton.

At a recent special meeting of the board of commissioners of Mineral county, C. D. Kaeding appeared in regard to constructing a power-line from Mina to Candelaria. It was tentatively agreed between the board and Mr. Kaeding, acting for the Candelaria Mines Co., that the company would build the lines and sub-station, the county furnishing $15,000 and the Candelaria Mines Co. bearing the rest of the cost. It was also agreed that money spent by the company would be rebated on its power-bill at the rate of 25% each month, and the line is to belong to the county. On account of starting of work at the Lucky Boy it was ordered that the transformer, which was removed from Mina, be returned to the mine.

Oreana.—According to officials of the Pershing County

Mines Co., high-grade gold-silver ore has been opened on the Montezuma claim at a depth of 90 ft. Silver predominates.

Tonopah.—The Tonopah Belmont Development Co. has made a 10% reduction in treatment-charges on all ores sampling over $20 in value, the new rates to become effective March 1. On ores valued at $20 and less, the rate will be $4.50 instead of $5.25 per ton. On ores sampling between $20 and $25 the charge will be $5 instead of $5.50. On ores having a value of over $25 per ton the new treatment-charge will be $5 per ton plus 10% on overcharge, making the charge on $30 ore $5.50 per ton, the rate increasing until a $50 product will be charged $7.50. The lower schedule is offered to stimulate development on the part of lessees, who complain that unless they are lucky in finding rich ore it does not pay to operate on the tribute system. Where large bodies of ore are available it is said that with a profit of 50c. per ton men can make better than miner's wages.

OREGON

Gold Hill.—P. X. Johnson and associates of Portland, with headquarters at Gold Hill, are developing the Clausen property. This tract adjoins the Kubli and Red Oak groups on the east, and is situated between these two mines and the Bill Nye group. The present work is driving the lowest level, which will cut the three parallel veins 410 ft. from the adit. Three upper adits, consisting of 500 ft. of drift, have uncovered 2000 tons of gold ore assaying from $9 to $34 per ton. The average width of the veins is 24 in. The works are at an elevation of 2700 ft. and in a heavily forested area. Power, compressor, drills, trackage, and other mine equipment have been purchased.——The recent find of rich free-milling ore on the 350-ft. level of the North Pole mine, 9 miles west of Gold Hill, is important. It is being operated by the owner, P. H. Robinson. The present equipment on the mine is a 2-stamp mill with 10 tons capacity.

Jacksonville.—The Opp mine, owned and operated by J. W. Opp, has purchased the Medford-Jacksonville electric and steam railroad; it will be operated in conjunction with the mine. This road extends from Medford on the main line of the Southern Pacific to Jacksonville and three miles out from Jacksonville into the timber past the Opp mine. This deal will result in new life in the mining district west of Jacksonville. The Opp mine will enlarge its stamp-mill to handle the output of smaller mines. The mill has a crusher, a Dorr classifier, one Wilfley and six Johnson concentrators, and four plates.

UTAH

American Fork.—There has been an unusually large snowfall in the Wasatch mountains this winter, and numerous snowslides have been the result. On February 11 a snowslide completely buried the compressor-building and bunk-house at the Midwest Development Co.'s property. Five men were asleep in the bunk-house, and had a narrow escape from death. A. W. Larson, manager of the Pittsburg mine, and Donald Chipman, a miner at the same property, were both injured by slides. The snow is eight feet deep in the canyon.

Bingham.—The local mines of the United States Mining Co. shipped 132,209 tons of ore in 1921, from which was obtained 32,173 oz. gold, 678,764 oz. silver, 20,548,505 lb. lead, 21,181,257 lb. copper, and 13,806,329 lb. zinc, the gross value of same being $2,460,455. Mining expense was $734,589; freight, $499,741; reduction charges, $1,433,908; construction $11,082, making a total deduction of $2,279,320, leaving net proceeds of $181,134.

The Montana Bingham Mining Co. shipped 23,595 tons of ore in 1921, from which was obtained 1401 oz. gold, 46,231 oz. silver, 26,210 lb. lead, and 1,597,367 lb. copper, the gross value of which was $197,455. After deducting all charges the net income for the year was $17,915.

Eureka.—The Chief Consolidated Mining Co. shipped 93,267 tons of ore in 1921, establishing a new record. Shipments the previous year totaled 82,430 tons. The metal production was 3363 oz. gold, 3,262,241 oz. silver, 12,496,433 lb. lead, and 11,563 lb. copper. The average gross value of the ore was $41.89 per ton; smelting, freight, and sampling, $18.65, leaving a net value per ton of $23.24. Mining, development, and overhead charges were approximately $19 per ton. The net earnings for 1921 were $362,728, and after the payment of four dividends, totaling $176,805, there was a surplus of $185,934, which brought the total surplus on January 1, 1922, up to $1,827,631. Development work during 1921 totaled 7.8 miles, bringing the grand total of such work up to 190,158 ft., or slightly over 36 miles.

The east drift at the Apex Standard mine cut a vein of silver-lead ore recently, which assayed 30 oz. silver and 29% lead. The shaft at this property is now down a distance of 900 ft., and drifting was started at that depth. The management states that drifting will be continued until the lime-beds, a short distance ahead, are reached.

Harry D. Fuller and Henry Barney, lessees in the Iron Blossom mine, have started suit against William Thomas and Leland Tuft for the alleged unlawful extraction of ores and minerals from ground covered by the plaintiff's lease. An injunction was obtained by Fuller and Barney to prevent the drawing of $20,000 from a Provo bank by the defendants, which is alleged to be the amount received for ores unlawfully extracted.

Ore shipments for the week ending February 11 totaled 136 cars, as compared with 156 carloads for the previous week. The Tintic Standard shipped 46 cars; Chief Consolidated, 41; Grand Central, 17; Eagle & Blue Bell, 9; Iron Blossom, 7; Victoria, 6; Centennial-Eureka, 3; Alaska, 2; Swansea, 2; Gemini, 1; Bullion Beck, 1; Colorado, 1.

Development work has been started on the 1800-ft. level at the Centennial-Eureka mine, according to John Enlund, superintendent. Water has been receding during the past year, and the company will be able to prospect deeper territory than has been possible heretofore. About 50 lessees are at work in the mine. During the past month, a shipment from the mine averaged 150 oz. silver per ton, while a small lot, consisting of a few tons, averaged between 800 and 900 oz. silver per ton.

Park City.—The raise from the 1300-ft. level of the Ontario mine, in the eastern section of the camp, is in promising territory. Ore has been found, but sufficient work has not been done to determine whether or not it is a continuation of the main Ontario vein.——Ore shipments from this district for the week ending February 11 totaled 2354 tons, of which the Judge allied companies shipped 1328; Silver King Coalition, 602; and Ontario, 324. Shipments the previous week totaled 2158 tons.——Numerous snowslides have occurred recently in Empire and Ontario canyons, as a result of which development work at the outlying mines and prospects has been seriously curtailed. The snow is from 30 to 40 ft. deep in some parts of the road leading to the Daly-Judge mine.

WASHINGTON

Oroville.—The Ruby Mining Co. is nearly ready to start milling operations, according to A. L. Goodell, metallurgist. Much development work has been done and a carload of crude ore, shipped to the Bunker Hill smelter recently, contained $100 per ton in silver.

Valley.—Plans are being made for the erection in Spokane of a plant for the manufacture of magnesite building material, recently announced F. M. Handy, general manager of the Western Materials Co. The expenditure is reported at $50,000. The equipment will include a crusher, Raymond mill, tube-mill, and mixing-bins. The rate of production will be 40 tons of the sacked product in eight hours, but this can be increased to 100 tons by the addition of a tube-mill. The mixture will consist of 10 tons of powdered magnesite, calcined at the quarry, 10 tons of powdered filler, and 20 tons of white sand.

A new tunnel is being driven in the property of the Admiral Mining Co. to give 300 ft. additional depth below the copper ore found there last summer. The work is being done at the rate of five feet daily, under the direction of H. E. Firth, superintendent. The company is one of the few Stevens county concerns which operated all last year. Last year a cross-cut opened the vein 100 ft. north of the old workings. At a depth of 200 ft. below the outcrop a vein was opened, showing five to six feet of ore carrying 4 to 11% copper.

WISCONSIN

Benton.—The Frontier Mining Co., an Indianapolis concern, which since 1908 has been one of the greatest producers of zinc ore in this field, operating at different times the Frontier, Calvert, Hird, Bull Moose, Burr, and Middie mines, will not again resume operations under the original incorporation. The mines, equipment, leaseholds, and mining rights will be sold to one of the other large groups operating in this field. At present there are conservatively estimated over 7000 tons of zinc ore, owned by the Frontier, unsold. For ten years the Frontier company paid annual dividends amounting to 27% annually, and during the intensive war period dividends ran as high as 67% in a single year. The Bull Moose and Middie mines are regarded as the two best producers at this time, but they have been idle for a year.

Livingston.—The Dale mine, operated by the Vinegar Hill Zinc Co., was shut-down on February 1, throwing 50 men out of employment. It is explained, however, that the shut-down is only temporary, pending alterations for enlargement of production at the National Zinc Separators at Cuba City, which treats all the low-grade zinc concentrate produced at the Dale mine.

Platteville.—The single-unit separating-plant operated formerly at the Climax Mining Co.'s plant is being dismantled and removed to the Enterprise Roasters, where the plant is being remodeled and enlarged in preparation for the handling of more low-grade zinc concentrate from the Block House mines. The Block House Mining Co. anticaptes a revival in the zinc-mining industry and is prepared with two mills to establish a daily output of 100 tons of zinc concentrate.

BRITISH COLUMBIA

Lardeau.—R. H. Graves, managing director of the Bullock Gold Mines, Ltd., reports that the company is developing nine lodes on its property at Poplar Creek, and that recently a Ross mill has been erected for testing purposes. The veins are well mineralized and samples have assayed from $8 to $30 in gold. A little platinum has been found in some of the ore.

Pouce Coupe.—The Imperial Oil Co. has shipped in three carloads of casing and other drilling supplies, and drilling operations, which have been suspended during the severe weather, are to be re-started on March 1.

Prince Rupert.—Assays made at the mine of the 20 tons of high-grade ore that is being shipped from the Silverado mine to Tacoma show an average of 700 oz. in silver per ton. A quantity of second-grade ore, averaging 200 oz. in silver per ton is on the dumps, but it is probable that this will not be shipped until better transportation has been arranged.

Sandon.—The Ruth mine, which is being operated by lessees, is said to be looking well; another car of ore has been shipped this month, making the third car since the mine was re-opened.——George Clark, who is operating the Chambers No. 1 mine, at Cody, has shipped a car of ore.——Fred McDonnel is developing a large body of milling ore at the Noonday group, and is saving clean ore for shipping.——The Rambler-Cariboo has been closed temporarily because of the danger to the miners from snowslides at this period of the year. The Noble Five mill, at Cody, and Clarence Cunningham's mill, at Alamo, are still idle, but it is rumored that the Cunningham mill is to be re-started soon. Cunningham is shipping high-grade ore from the Queen Bess mine, which for long has been the best producer of his group. The Bosun mine, at New Denver, is operating steadily with three shifts, and is shipping regularly.

Terrace.—J. M. Hoar, of Seattle, who bonded the Bear and Wolf groups, on Maroon mountain, has added two more Ross mills to the equipment of the plant, the one Ross mill that was erected last year being insufficient to handle the quantity of ore that is being mined.——D. A. Buchanan has been developing a 10-ft. lode, running well in silver and carrying a little gold, on the Gabriel group, at the head of the Kaitmaikawa river, during the winter; he has built six miles of road that will connect his property with the main highway.

Trail.—The ore receipts at the smelter during the first week in February amounted to 8855 tons; the following mines contributed to the total: Bell, Beaverdell, 40 tons; Josie, Rossland, 70; Paradise, Windermere, 30; Queen Bess, Three Forks, 30; and the Consolidated company's mines, 8685.

Victoria.—S. P. Silverman, president of the Tidewater Copper Co., passed through here on his way to the company's Indian Chief mine, at Sidney Inlet, where operations recently have been resumed, after a shut-down of 14 months. Silverman stated that from now on he expected the mine would be producing from 300 to 350 tons of copper concentrate monthly, which would be shipped to the Tacoma smelter. A large body of ore has been developed, and as the mine has been opened by tunnels, avoiding all pumping cost, and all the machinery at mine and mill is run by water-power, the operating expenses are low. A profit is anticipated even at the present price of copper. Besides copper, however, the ore contains a large amount of magnetite, and some molybdenum and nickel, and experiments are being made by the British and German steel interests to discover if the material that the company could produce as a by-product can be used in the manufacture of a molybdenum-nickel steel. The mine and mill are giving employment to 80 men.——F. N. D. Rosher, of the Valdez Island Copper Co., is authority for the statement that some ore from the company's Quadra Island mine shows marked radio-active properties. Photographs of metal objects are said to have been made by the rays emitted by the ore, and the ore is said to excite a scintillascope. Samples of the ore have been sent to McGill University, the United States, and England for further investigation.——The Provincial government has decided to construct a road from Hanceville to the new gold discovery that was made in the Whitewater river district last autumn.

MEXICO

Chihuahua.—In the Jiminez district a group of Chicago, Buffalo, and Milwaukee men, headed by C. P. Hugo Schoellkopf of Buffalo, have taken over the Adarges lead and silver mines and are expending a large sum in improvements, which consist of the construction of a railroad 14 miles long, an automobile highway 48 miles long, and an electric-power transmission-line which is to bring power to the mines from the hydro-electric plant of the Mexico Northern Power Co. at Boquillas. An ore-reduction plant and modern mining machinery will be installed. It is planned to increase the ore production so that by May 1 not less than 500 tons will be gotten out each day. According to engineers who have reported on this property, the ore runs high in lead, silver, and gold. The average value, it is said, is around $35 per ton.

Francisco Villanuevo and a number of associates have taken over the San Pedro mine, comprising eight claims, the ore carrying gold, silver, and copper. The property is situated in the Vensor mountains near the city of Chihuahua.——Francisco Navarro has located the Amaltea group in the Santa Eulalia silver-lead district. The new location lies near the Don Guillermo, La Peruana, and Enrique mines.——The Ampliacion de la Bandera Mexicana, a group of 89 claims, has been denounced by Apolonio Sanchez. The property is situated in the Brecha mountains, municipality of Villa Gonzales, where recent discoveries of lead, zinc, and silver have been made.

Mazatlan.—The National Mining Corporation of London has purchased the Silla group of mines, situated on the Pacific coast, 60 miles east of here. The company plans to make extensive improvements to its property.

Torreon.—G. W. de Land, representing the Crown City Lease Syndicate, of Pasadena, California, has obtained from Carlos Arriaga, owner of the San Jacinto and Refugio ranches, situated a short distance west of this city, a lease to explore for oil. Geologists of various nationalities have often examined this region and declared that oil exists in the sub-soil. De Land, immediately after closing the contract, left for the United States in order to procure machinery for sinking the first well. He expects to start active drilling within 90 days. The Crown City Lease Syndicate has extensive oil holdings in the south-western part of Texas.

Zacatecas.—A number of the old mines in this State have been declared forfeited by the former owners due to the non-payment of taxes during the past several years and are now open for re-location. A rush has been made to acquire possession of some of the best of them by resident miners who are acquainted with the contents and possibilities. When two or more applicants apply for filing at the same time, lots are drawn to decide who shall be allowed the claims. El Nazareno, a group of two claims, in the Noria de San Pantaleon camp of the Sombrerete district has been re-located by Francisco Palacios, of Chalchihuites, and will have it titled under the name of Vicente Guerrero. In this same vicinity La Soledad mine was forfeited and re-denounced by Gerardo Breceda, who has asked to have it re-titled under the same name. Both of these properties carry gold and silver ore.——Luciano Robles, of the city of Zacatecas, has located some new ground near this city, where he is surveying a group of five pertenencias to be titled as the Gallega. It is situated near the Daisy-Violeta mine, south-east of this city.——Ore shipments from the Sombrerete and Chalchihuites districts are being increased. Most of this ore is consigned to the A. S. & R. smelter at Asarco.

ONTARIO

Beaverhouse Lake.—The Argonaut has placed orders for machinery for a new mill of 100 to 150 tons daily capacity.

Cobalt.—The Nipissing during January produced silver of an estimated net value of $139,622, the output being considerably smaller than usual, as the mill was shut-down one week for the annual clean-up. A winze on vein 251 has a 45-ft. depth of ore running 7573 oz. per ton over a width of 3 in.——At the Victory mine a 6-in. vein of high-grade ore has been discovered on the 300-ft. level, some of which carries 2000 oz. of silver per ton. The shaft will be put down to about 375 ft.——The Coniagas has a working option on the Ruby and will begin diamond-drilling early in March.

Kirkland Lake.—A new company to be known as the Hunton Consolidated, capitalized at $3,000,000, is being organized to take over the Hunton property and two adjoining claims known as the Gibson-Duncan on the west and the Slaght-Solomon Fraction on the east. The merger has been approved by the directors. The new company will have a holding approximately one mile in length along the zone of mineralization.

Mill of the McKinley-Darragh-Savage Company at Cobalt

Porcupine.—The shareholders of the Dome Mines have approved the proposal of the directors for the re-payment of capital and the reduction of the par value of shares from $10 to $9.——A special general meeting of the shareholders of the McIntyre has been called for February 23 to authorize the raising of the par value of shares from $1 to $5.

At the McIntyre preliminary work for the building of an addition to the mill for the treatment of high-grade carbonaceous ore is in progress. The new unit will increase the milling capacity from 550 to 800 tons daily.——The Hollinger Consolidated continues to maintain its high record of production. During the four weeks ending January 28 the mill treated 111,206 tons of ore, being an average of 3972 tons per day.

The Beaumont has obtained highly satisfactory results from extensive diamond-drilling from the 300-ft. level. The management has arranged to spend at least $300,000 during the year on development, including the sinking of the shaft down to 1500 ft., the installation of electrical equipment and of a ball-mill.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Dave Land is at Winthrop, California.

Albert Burch is on his way to Arizona.

A. G. McGregor is at Washington, D. C.

Hector McRae has returned to St. Louis from London.

L. Maurice Cockerell has returned to London from Mexico.

E. T. Telford, of Lompoc, California, is in San Francisco.

S. S. Worley, of Gold Hill, Nevada, has gone to Mexico City.

W. H. Seamon, Jr., of Lakeland, Florida, is at El Paso, Texas.

Spangler Ricker of Berkeley, California, is at Inspiration, Arizona.

J. W. Furness, formerly at Philadelphia, is at Pearce, Arizona.

Samuel H. Dolbear is at the asbestos mines near Tetford in Canada.

R. Lyman, of Jamestown, California, has moved to Salt Lake City.

Frank H. Madison has moved from Butte, Montana, to Washington.

Conway G. Williams has moved from Jackson, Missouri, to Garfield, Utah.

George H. Garrey, of Philadelphia, is at the Mizpah Hotel, Tonopah, Nevada.

Edgar A. Rush has returned to Kasaan, Alaska, from Connellsville, Pennsylvania.

J. E. Spurr, editor of the 'Engineering & Mining Journal', is on a visit to San Francisco.

Charles H. Fulton, Director of the Missouri School of Mines, attended the Institute meeting in New York.

Bernard MacDonald has returned to Parral from an examination of mines at Indé in the State of Durango.

S. F. Shaw is in charge of the Parreña mine, in the Sierra Mojada, as well as manager for the Constancia company.

E. P. Mathewson sailed from Rangoon for Shanghai on January 19; he expects to reach San Francisco on March 23.

R. A. Sulliger, who has been with the Dolores Mines Co., at Madera, Chihuahua, Mexico, is at Long Beach, California.

Frederic R. Weekes has gone to Venezuela on professional business. He expects to return to New York in about two months.

R. D. Maxfield, president of the Maxfield Mining Co., at Alta, Utah, has returned to Salt Lake City after an extended trip in the East.

Harold A. Linke has returned to Salt Lake City after spending a year as mining engineer at the U. S. Smelting Co.'s mine at Pachuca, Mexico.

Edward L. Sweeney, formerly metallurgist with the Kennecott Corporation, passed through San Francisco on his way from Vancouver to Bisbee.

Arthur Thacher of St. Louis is attending the annual meeting of the Institute in New York and will go from there to Charleston, to assist in starting another local section.

H. A. Major, superintendent of the Spanish Fork (Utah) sugar factory, has accepted the position of superintendent of the Chief Consolidated Mining Co.'s quarry at Eureka, Utah.

James Irving, of James Irving & Co., Los Angeles, has recently made an examination of the properties of the Consolidated Mines Syndicate in the Cunningham Pass mining district, Yuma county, Arizona.

G. T. Van Winkle, consulting metallurgical engineer of Salt Lake City, gave an address on the 'Uses of Copper' before the Utah Society of Engineers on February 15. **S. M. Soupcoff**, mining engineer for the American Smelting & Refining Co., at Salt Lake City, spoke on 'Exploration of Mines'.

E. C. Morse, who for the past season has been in charge of the mill of the Premier Gold Mining Co., at Premier, British Columbia, has returned to his home at Snohomish, Washington. **Bert F. Smith** has charge of operations during the absence of the manager, **Dale L. Pitt**, who is absent on a holiday.

Obituary

W. A. Bostwick, president of the International Nickel Co., died on February 4, at Bronxville, New York.

Benjamin S. Hammill, president of the Caribou Placer Co. of Idaho, died at his winter home in Florida on February 11. He was a resident of Pittsburgh, Pennsylvania, but had a wide acquaintance in Utah and Idaho, where he had visited many times.

Lucien H. Norton died suddenly on February 10 at Denver, Colorado, while on his way to Douglas, Arizona. He was born at Bridgeport in 1866 and was graduated from Phillips Exeter Academy, going later to Lehigh College, and then to the Columbia School of Mines, from which he graduated in 1886. His first employment was on the engineering staff of the New Haven railroad; then he was at a mine in San Domingo. In 1890 he came West, to be employed by the Pennsylvania Lead Co. at Salt Lake City. In 1895 he moved to Monterrey, Mexico, as chief assayer for the Guggenheim smelter at that place. He remained there for five years. Two years, 1900-1902, were spent at Cripple Creek, and then he became superintendent for the Humphreys Mining & Milling Co. at Creede. In 1908 he joined A. P. Root, Jr., in a partnership as assayers and chemists. His death is deeply regretted by his partner and by many other friends.

Frank W. Parker died at El Paso, Texas, on February 11 of pneumonia. He came to White Oaks, New Mexico, with his parents in 1882, when his father was part owner and manager of the South Homestake gold mines. He afterward attended the Manual Training School in Washington University, St. Louis, and followed the mining business all his life. After leaving White Oaks he was mine foreman of the Gongresso and Leon mines of the Candelaria Mining Co. at San Pedro de Corrallites, at Chihuahua, Mexico, for several years. From there he engaged in mining on his own account near Parral. He was waylaid and robbed by Mexicans, and on account of his family decided to leave that country. He unwatered and examined the Gold Hill mine near Quartzburg, Idaho, with John A. Foley, his brother-in-law. Afterward he took a lease and built a mill on the Sunday mine. He was mine foreman, then superintendent, of the Rainbow mine, in Rye valley, Oregon, for the United States Smelting & Refining Co., from April 1912 until September 1916, where he made an enviable record. For the past two years he has been connected with his brother, James H. Parker, in the operations of the Oro Iron Co.'s iron mines at Ohayai, New Mexico, about 45 miles north of El Paso. He leaves a wife and three daughters, two of whom live with their mother at El Paso, the third, Mrs. N. H. Erskine, at Oakland, California.

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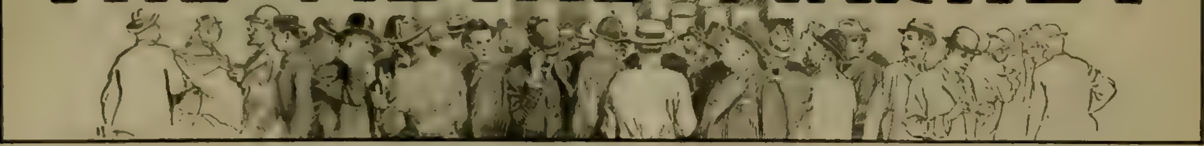
THE METAL MARKET



METAL PRICES

San Francisco, February 21

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	14.25—14.75
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$90
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.50—7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

February 20.—Copper is inactive and lower. Lead is active and firm. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence
Feb.	14	66.37½	34.37½
"	15	66.12½	34.37½
"	16	65.37½	33.87½
"	17	65.50	34.12½
"	18	64.37½	33.25
"	19 Sunday		
"	20	64.87½	33.37½

Average week ending		Cents	Pence
Jan.	9	64.90	34.83
"	16	66.06	35.31
"	23	65.27	34.90
"	30	65.46	35.06
Feb.	6	66.35	35.00
"	13	65.75	34.22
"	20	65.44	34.23

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	132.77	65.95	65.45	July	92.04	59.99	....
Feb.	131.27	59.55	....	Aug.	96.23	61.59	....
Mch.	125.70	56.08	....	Sept.	93.66	66.22	....
Apr.	119.56	59.33	....	Oct.	83.48	71.00	....
May	102.69	59.90	....	Nov.	77.73	68.24	....
June	90.84	58.51	....	Dec.	64.78	65.76	....

COPPER

Prices of electrolytic, in cents per pound.

Date		
Feb.	14	13.00
"	15	13.00
"	16	12.87½
"	17	12.87½
"	18	12.75
"	19 Sunday	
"	20	12.75

Average week ending		
Jan.	9	13.56
"	16	13.62
"	23	13.54
"	30	13.48
Feb.	6	13.29
"	13	13.17
"	20	12.88

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	19.25	12.94	13.54	July	19.00	12.46	....
Feb.	19.05	12.84	....	Aug.	19.00	11.71	....
Mch.	18.49	12.20	....	Sept.	18.75	12.03	....
Apr.	19.23	12.50	....	Oct.	16.53	12.66	....
May	19.05	12.74	....	Nov.	14.63	13.07	....
June	19.00	12.83	....	Dec.	13.18	13.54	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		
Feb.	14	4.70
"	15	4.70
"	16	4.70
"	17	4.70
"	18	4.70
"	19 Sunday	
"	20	4.70

Average week ending		
Jan.	9	4.70
"	16	4.70
"	23	4.70
"	30	4.70
Feb.	6	4.70
"	13	4.70
"	20	4.70

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	8.65	4.96	4.70	July	8.63	4.75	....
Feb.	8.88	4.54	....	Aug.	9.03	4.40	....
Mch.	9.22	4.06	....	Sept.	8.08	4.61	....
Apr.	8.78	4.32	....	Oct.	7.28	4.70	....
May	8.55	5.01	....	Nov.	6.37	4.70	....
June	8.43	4.57	....	Dec.	4.76	4.70	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	62.74	35.94	32.04	July	49.29	27.69	....
Feb.	59.87	32.16	....	Aug.	47.60	26.35	....
Mch.	61.92	28.87	....	Sept.	44.43	26.70	....
Apr.	62.17	30.36	....	Oct.	40.47	27.70	....
May	54.99	32.50	....	Nov.	36.97	28.93	....
June	48.33	29.39	....	Dec.	34.12	32.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		
Feb.	14	4.85
"	15	4.85
"	16	4.85
"	17	4.85
"	18	4.85
"	19 Sunday	
"	20	4.85

Average week ending		
Jan.	9	5.16
"	16	5.11
"	23	5.04
"	30	4.93
Feb.	6	4.85
"	13	4.84
"	20	4.85

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	9.56	5.86	5.05	July	8.18	4.41	....
Feb.	9.15	5.34	....	Aug.	8.31	4.69	....
Mch.	8.93	5.19	....	Sept.	7.84	4.74	....
Apr.	8.76	5.37	....	Oct.	7.50	5.09	....
May	8.07	5.37	....	Nov.	6.78	5.18	....
June	7.92	4.96	....	Dec.	6.03	5.24	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Jan.	24	50.00	Feb.	7	50.00
"	31	50.00	"	14	50.00
			"	21	50.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	89.00	50.00	50.00	July	88.00	47.75	....
Feb.	81.00	48.75	....	Aug.	85.00	47.50	....
Mch.	87.00	45.88	....	Sept.	75.00	47.50	....
Apr.	100.00	46.00	....	Oct.	71.00	46.25	....
May	87.00	50.00	....	Nov.	56.00	40.40	....
June	85.00	49.50	....	Dec.	52.50	49.50	....

W. P. HARDING, GOVERNOR OF THE FEDERAL RESERVE BOARD, PREDICTS LONG PERIOD OF PROSPERITY

The United States faces a period of prosperity of longer duration than the country has known in its history—a period marked by saner business methods—W. P. Harding, Governor of the Federal Reserve Board, says in his annual report to Congress.

Governor Harding's diagnosis of the nation's business condition and business prospects was linked with a review of finances which show that the country has about reached the end of deflation. Easing of credit, a more confident feeling in the investment market, and broader plans of business generally, were cited to Congress as favorable factors now in evidence.

"For some months past there has been a marked easing in domestic rates of interest," Governor Harding said. "Notwithstanding some unfavorable features in revenue laws, the investment market now is absorbing securities at reasonable rates, which could not have been considered a few months ago. Market quotations for Liberty bonds have steadily advanced until they are now approaching par. Good railroad and industrial bonds have appreciated and there have been noticeable advances in standard stocks.

"There are those who believe the beginning of revival is not far distant. When it does definitely set in, it will be followed in due course by an era of prosperity. In the light of recent experience, we should remember, when we again enter the period of full prosperity, that a reaction will follow sooner or later. If the flow of the incoming tide can be controlled so that the crest may not be reached too rapidly, nor rise too high, the subsequent reaction will be less severe, and the next period of commercial and industrial activity will be marked by saner methods, greater achievement along constructive lines, and by longer duration than we have had before."

The earning assets of all Federal Reserve Banks, the report said, amounted on December 28, 1921, to $1,535,851,000, compared with $3,263,027,000 on December 31, 1920, a reduction of 53%, which was accompanied by a steady increase in gold reserve and an almost continuous decrease in Federal reserve-note circulation.

Gross earnings of the Federal Reserve Banks for 1921, the report continued, amounted to $122,865,000, compared with $181,297,000 in 1920. Member bank borrowings, according to the report, showed a continuous decline from $2,687,000,000 at the end of 1920 to about $1,144,000,000 at the end of 1921, due to a reduction of over $900,000,000 in the volume of Federal Reserve notes in circulation. On December 28, the report continued, the Federal Reserve Banks held a gold reserve of $2,870,000,000.

MONEY AND EXCHANGE

Foreign quotations on February 21 are as follows:

Sterling, dollars:	Cable	4.40
	Demand	4.39½
Franc, cents:	Cable	9.16
	Demand	9.14
Lira, cents:	Demand	5.04
Mark, cent:		0.46½

Eastern Metal Market

New York, February 15.

Little change is discernible in any of the markets and they are all quiet.

Demand for copper is light and offerings from speculative sources have forced quotations down.

The tin market continues active one day and dull the next. Prices have declined.

The lead market is steady and strong.

Buying of zinc is still light but quotations remain steady to firm.

Monday, February 13, was generally observed as a holiday.

IRON AND STEEL

Operations of steel mills have improved slightly following the broadening scale of purchases last week, but fresh buying has decreased somewhat, as is characteristic of the alternations of a replenishment market. Both consumers and jobbers are freer buyers, but only for immediate needs. The week's bookings have relatively few items of large tonnage. The potentialities of railroad demand, in the light of recent sales of equipment, are again encouraging producers.

The heavy tonnage products are none too steady, but the uninterrupted succession of reports of operating losses sustained by large producers appears to have done much to discourage belief in lower prices. Some observers regard possible freight-rate reductions as already discounted.

COPPER

Demand does not improve and quotations continue to decline. There is not enough buying to sustain the market and there are sufficient offerings from weak or speculative hands to depress prices. Electrolytic copper is quoted for February-March delivery at 13.25c., delivered, or 13c., New York or refinery, but the amount sold or obtainable at these prices is not large. It is sufficient, however, to meet the going demand. Large producers are either out of the market or have not revised their ideas of market prices to as low a level as the one referred to. Their minimum is now 13.50 to 13.62½c., delivered, as against 13.75 to 14c., recently. The whole situation is a recurrence of similar ones which have prevailed under like conditions—the necessity of holders of contracts for copper to sell or liquidate by certain dates, a situation which prevailed in the third quarter of last year.

TIN

The Straits tin market continues active in spots with dullness the prevailing condition. Except on last Friday, February 10, almost no business was done, dealers being apathetic. On that day, however, some business is reported with estimates of sales up to 600 tons, mostly futures and mostly to consumers. Monday was a holiday and yesterday the market was dull. Price declines have been gradual but successive on each day until spot Straits tin was quoted yesterday at 30.75c., New York, as compared with 32c. a week ago. The London market is also lower than a week ago by about £4 per ton with yesterday's quotations at £152 for spot standard, £153 15s. for future standard, and £154 10s. for spot Straits with fair sales reported. Arrivals thus far this month have been 1600 tons with 8060 tons reported afloat.

LEAD

This market continues to maintain the steady stream of business which has prevailed so long. Consumption is still about equal to production and there are no features and no causes for price changes. The leading interest continues to quote 4.70c., both New York and St. Louis, while the outside market is unchanged at 4.40c., St. Louis, or 4.70 to 4.75c., New York and Eastern points.

ZINC

No improvement is reported unless the absence of any further decline in prices is one. The market has remained substantially at its present level for over two weeks and hence is not weak. Demand is still confined to small and carload lots which are generally sold at the prevailing quotation of 4.50c., St. Louis, or 4.85c., New York, for prime Western in wholesale lots for February-March delivery. A slight shading of this price is reported on one or two days last week.

ANTIMONY

In a quiet market quotations are unchanged at 4.40c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, can still be bought from the leading producer at 19 to 19.10c. per pound, f.o.b. plant, depending on the quantity, while importers of foreign aluminum of the same grade ask 17 to 18c., New York, duty paid.

ORES

Tungsten: Demand is very light and quotations are nominal and unchanged at $1.85 to $2 per unit for Chinese concentrates, other grades ranging higher depending on the ore and the quantity.

Molybdenum: While there is a little inquiry, hardly any business has resulted and quotations are nominally unchanged at 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: There have been no developments and quotations are nominal at 22 to 25c. per unit, seaboard, for high-grade ore. The asking price is 25c., but the last sale was made at 22c. per unit.

Chrome: There is no change in conditions and quotations remain nominal at $20 per unit and higher, c.i.f. Atlantic parts.

FERRO-ALLOYS

Ferro-manganese: The American and British markets are now on a basis of $62.50 per ton, seaboard. Sales of about 1000 tons were made before the advance took place and there are inquiries totaling 500 tons. The market is firm.

Spiegeleisen: The stocks of the 20% grade have been exhausted and no more is available. As a result the lower, or 16 to 19%, grade has been sold at an advance of $5 per ton, or $30, furnace, which is now the market. Sales have totaled about 500 tons and the market is strong.

Ferro-tungsten: Dullness pervades almost to the point of stagnation and quotations are unchanged at 40 to 45c. per pound of contained tungsten with the foreign alloy quoted at 50c., f.o.b. Atlantic ports.

Ferro-chrome: There is no improvement in demand and quotations stand unchanged at 12 to 14c. per pound of contained chromium, delivered, in standard alloy, depending on composition and other conditions.

The rolled steel used during 1922 for the manufacture of automobiles is estimated to be in the neighborhood of 700,000 tons. Present productive capacity is 40,000,000 gross tons per year, while the average rate of production in the past three months has been about 16,600,000 tons per year. Of these quantities 700,000 tons is 1.75% and 4.2% respectively.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

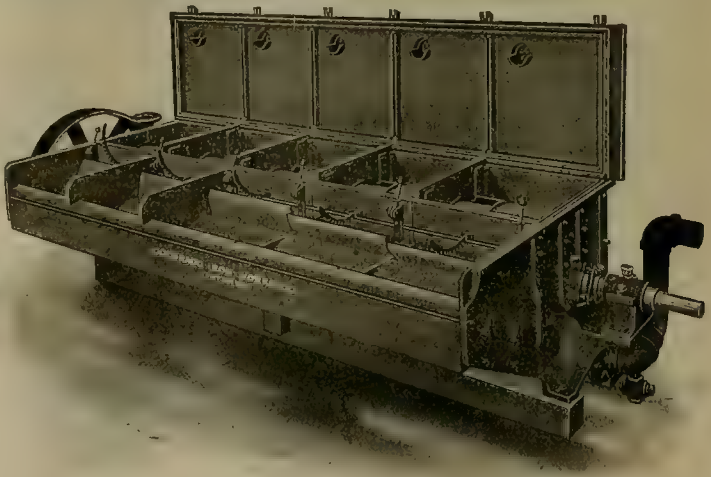
THE AKINS FLOTATION MACHINE

The underlying principle on which the Akins flotation machine is designed, is original, and different from that employed in any other flotation machine on the market. The method used in the Akins machine consists in successively taking definite quantities of a froth-producing, mineral-containing liquid and air, and commingling them to thoroughly aerate the same, and thereafter releasing these below the surface of a body of similar liquid to effect the frothing thereof. In applying this method to the flotation process, the Akins machine is not dependent on any extraneous source for air-supply or emulsification, nor does it require a high speed of rotation to effect the commingling of the measured air and liquid; hence the wear is reduced to a minimum, as well as the power-input to the machine. In addition, the amount of frothing in each cell is at all times under control of the operator. The method of air supply and its positive control, does away with close attention, so that in a plant having a large number of machines, one operator can easily attend to many of them.

The tank is regularly constructed of wood, with cast-iron ends. The top or cover of the tank is removable, to give access to the interior. Vertical partitions divide the tank into a number of cells, the only communication between them being through openings at the bottom to permit the passage of pulp from one cell to the next. In front of, and integral with, each cell, is the usual spitzkasten, in which is placed at about the liquid level a screen slightly inclined from the horizontal, and used as a baffle to create a quiescent area for the froth; and a booster board which is slightly above the level of the froth-overflow weir. This board is adjustable as to its inclination, and causes the froth to flow toward the weir without the use of sweeps. For larger units the tank can be built of concrete or other suitable material if desired.

Mounted on the cover above each cell and over the rotor, is a valve, conveniently placed for adjustment by the operator, by means of which admission of air to the cell is controlled and the amount of frothing and grade of concentrates produced is regulated. As the cells are practically airtight, by closing this valve on any cell the same can be used as an emulsifier when adding reagents in that cell, and no frothing action takes place in that cell so long as its valve remains closed. Agitation without aeration will not produce frothing, hence there can be no flotation without aeration of the pulp.

The rotor or aeration member is similar in form to a multiple scoop tube-mill feeder, that is, it comprises two discs with a series of partitions which form passages leading spirally from the periphery to the centre. The rotor is mounted on the horizontal shaft of the machine, and in operation is partly submerged in the pulp, the unsubmerged portion extending into the air-chamber of the cell. It is rotated in the direction which causes each spiral passage to take in air when above the liquid level, this air being trapped as the opening enters the pulp, and on reaching the lower part of its revolution it takes in a measured quantity of pulp. The air-chamber of the cell being practically air-tight, the action of the rotor, if air were not admitted, would be to exhaust the chamber of its contained air. Indeed, with the air-valve closed there is a decided rise in the level of the pulp in the air-chamber, and the regulation of air really rests upon this difference of level; when low, due to free admission of air, the measure taken in by each scoop is much larger than when a restricted admission of air causes the pulp to rise, thereby filling a larger portion of the spiral passages and leaving a correspondingly smaller space for the air. In the centre of one side of the rotor is an opening communicating with the interior of the diffusion member, and through this opening the measured volumes of pulp and air pass.



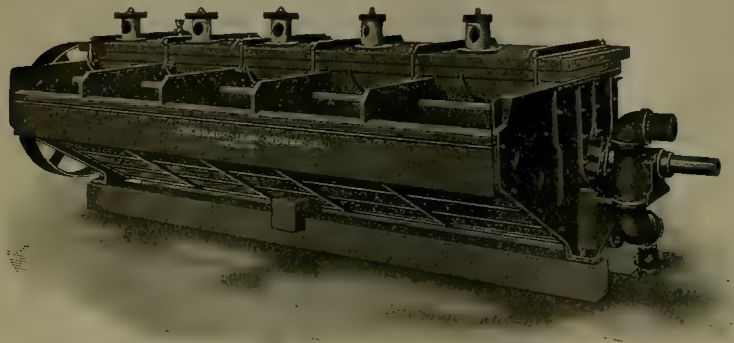
The diffusion member consists of a series of three concentric hollow cylinders perforated with square holes. It forms a prolongation of the rotor, and one end is closed by the end wall of the rotor (except for the central opening just mentioned), the other end being closed by a disc attached to the shaft.

The pulp and air flow through the central opening in the rotor into the innermost of the perforated cylinders and pass successively through all three of them. The rotation of the diffusion member causes the air to be broken up into minute bubbles thoroughly commingled with the ore particles, so that through the outer cylinder there issues a thoroughly aerated mixture in an ideal condition for flotation.

There is a general flow of this aerated pulp below the front wall of the diffusion-chamber into the spitz. The froth formed rises mainly between the front wall of the diffusion-chamber and the booster-board, the purpose of this being to direct the flow of the froth toward the overflow-weir. Any mineral particles not thus recovered upon their first passage through this circuit, pass back into the rotor, or into the next cell, depending upon the rate of feed of material into the machine.

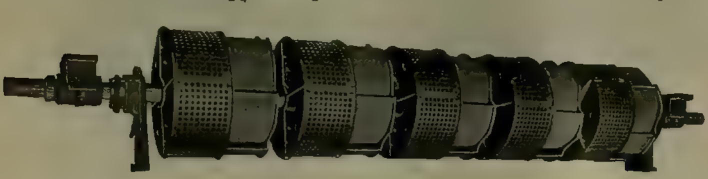
An oil-feed cup is furnished on the first cell of each machine for feeding the oil into the differential or aeration compartment. A flange, to which an oil-feed can be attached, also is furnished on each subsequent cell, except the last two in each machine. This enables the operator to add oils or reagents to such cells as desired.

The horizontal drive-shaft, where it passes through the stuffing boxes, is fitted with a renewable steel wearing-sleeve. The top and ends of the machine are so constructed that the drive-shaft with the rotors and diffusion members can be removed intact in a few minutes.



The pulp-feed is brought to the machine at a point about 18 in. above the centre line of the rotor, and enters the first compartment at the bottom. With a feed of 50 tons of solids and 250 tons of water, and a speed of 55 r.p.m., the pulp theoretically will pass through the rotors and diffusion members 25 times before passing on to the next cell. As there are three sets of the perforated plates to pass through, the pulp and air are thus intimately mixed 75 times in each cell.

The manufacturer supplies a piece of wire screen for the pulp inlet to each machine, to be placed in the feed-box for the removal of any coarse wood fibre or other foreign matter in the pulp.



The tailing passes from the machine at the bottom of the tank through an adjustable discharge-overflow, and the level of the pulp in the machine can be varied by means of a small hand wheel. The tailing discharge is provided with a plug cock for drainage of the machine when desired, but in starting up after a shut-down, it is not necessary to drain it.

The main point in belting up the machine is that the rotor must revolve in the direction indicated by the arrow on the head end of the machine, so that the spiral passages take in the air and pulp and force them inward toward the centre of the rotor. The frothing in the cells is regulated independently of each other to a close degree by varying the amount of air admitted through the regulating valves on top of the aeration-chambers and, as stated before, the pulp-level is regulated by adjusting the discharge-overflow. These, when once set for the ore and reagents in use, should require no further adjustments, so that when once regulated for the conditions the machine requires practically no attention. There are no pulp valves or slides requiring adjustment and liable to get out of order, and the machine is as nearly free from liability to derangement by unskilled hands as human ingenuity can possibly make it.

The standard machine, having a rotor 24 in. diam., is run at a speed of but 55 to 60 r.p.m., and requires less than one-half horse-power per cell. At this low speed, the frothing action is actually more active than in so-called high-velocity machines. It must be remembered that the Akins machine does not depend upon velocity of the rotor to emulsify the pulp and produce frothing.

COMMERCIAL PARAGRAPHS

An agreement has been made whereby the Garred-Cavers process of powdered-coal firing will be applied to the blast-furnaces of the Union Minière du Haut-Katanga in the Belgian Congo, Africa, for the smelting of copper ores. U. S. Garred, president of the **Garred-Cavers Corporation,** left New York on Janury 17 for the Belgian Congo to supervise the installation of the equipment.

'Bulletin 1000', published by the **Traylor Engineering & Manufacturing Co.,** of Allentown, Pennsylvania, is a convenient pocket edition of the general catalogue. It does not attempt to give details regarding any of the machines or equipment listed, but lists many of the principal products and gives references to literature describing them fully. It is copiously illustrated and should be valuable to the engineer.

A newly developed dynamite which, it is announced, will prove an important factor in reducing costs in quarrying, and other open work, has just been perfected by the Du Pont company. The new 'powder' is known as 'Dumorite' and is made with a double base of modified nitroglycerin and guncotton. It cannot freeze and does not produce headache. In putting 'Dumorite' on the market, the Du Pont company announces that the explosive will effect savings of one-third on the dollar. It is as powerful, stick for stick, under ordinary conditions, as regular 40% dynamite, its economy consisting in the fact that each case contains approximately one-third more sticks.

Announcement is made by the New York branch of the **Electric Storage Battery Co.** of the consolidation of its various offices in that city. That part of the sales force, formerly situated at the Exide factory branch, 64th street and West End avenue, has been moved to the New York branch office at 23-31 West 43rd street, which will hereafter be the headquarters also of the export-sales department. Under the new arrangement, F. L Kellogg, manager of the North Atlantic district embracing the New York, Boston, and Rochester branch territories; F. F. Sampson, New York branch manager; and J. F. Kelly, Jr., export-sales manager, will be at the West 43rd street offices.

Wherever exhaust steam can be used for heating or other purposes, pumps driven by steam-turbine are unequalled for economy. In such cases power can be obtained for nearly nothing, as approximately 90% of the heat contained in the live steam fed to the turbine is available in the exhaust, and can be used at pressures up to 15 lb. The exhaust steam is entirely free from oil, due to the fact that no internal lubrication is necessary. For this reason turbine drive is of especial advantage in industries where entire absence of oil in the exhaust steam is absolutely necessary. Furthermore, the condensed steam can be used for boiler feed, without danger from oil in the boiler. In Bulletin No. 123 the **Goulds Manufacturing Co.,** of Seneca Falls, New York, describes a compact unit consisting of a Goulds centrifugal pump, direct connected to a Lee steam-turbine.

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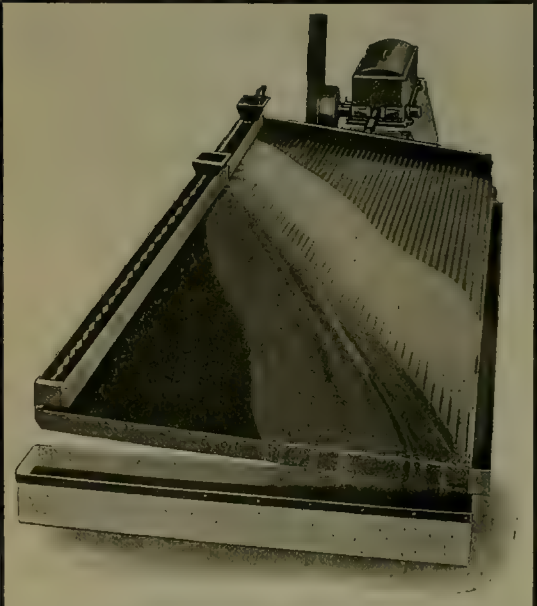

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T. A. RICKARD, ... Editor

Publisher's Announcement

As publishers of the 'Mining and Scientific Press' it is our duty and pleasure to announce the consolidation of this paper with the 'Engineering and Mining Journal'. The time has come when the publishers of the two leading mining periodicals of the United States feel that they can perform a better service for the mining industry jointly than severally, so they have agreed to merge the two publications in a weekly paper to be known as the 'Engineering and Mining Journal-Press'. This announcement by our company would be tinged with deep regret if it meant that the traditions of the 'Mining and Scientific Press' were to be forgotten; on the contrary, as publishers of this paper we look forward confidently to perpetuating our traditions under conditions permitting of larger scope and greater usefulness. Mr. J. E. Spurr of the 'Engineering and Mining Journal' will be editor of the 'Journal-Press' with headquarters at New York, and Mr. T. A. Rickard, with continuing residence in San Francisco, will devote particular attention to the mining interests of the Pacific Coast as contributing editor of the consolidated paper. The best talent on the staffs of both papers will be retained in order to expand the field of editorial review. It is intended to give increased attention to non-metallic minerals, which came into industrial prominence during the War and are essential to the great steel manufactures of this country.

The 'Mining and Scientific Press' was founded in 1860; the 'Engineering and Mining Journal' in 1866. They have been rivals, but they have pursued the same policy in all essentials; both have been independent as organs of opinion; both have been spokesmen for the highest ideals of the mining profession and the best interests of the mining industry. They will find it easy to co-operate in a common endeavor to give the United States a truly national mining paper. Moreover, both have many readers and friends in foreign lands, especially in the English-speaking countries. To them the 'Journal-Press' will come as an old friend, invigorated and matured, but still the same.

The merger goes into effect on April 1. An editorial statement will appear in our issue of March 25. The subscription price of the 'Journal-Press' will be $4 per annum. All advertising contracts will be continued without change.

To our subscribers and advertisers we send greeting. We bespeak their continued interest and support, believing confidently that they will join with us in accepting the consolidation as an accomplishment advantageous to all concerned, particularly themselves.

DEWEY PUBLISHING CO.
T. A. RICKARD, President.

San Francisco, March 1.

A RECENT Institute notice states that Volume LXV of the Transactions, on gas and petroleum, is ready for distribution. "It is to be understood", we are told, "that every member is entitled to this volume without extra charge, but by waiving his right to a volume in which he is not interested, he is assisting the Institute in solving its publication problems". The principal 'publication problem' is 'Mining & Metallurgy', for the monthly receipt of which no member of the Institute can waive his right, whether he be interested in it or not.

AMERICAN SMELTERS SECURITIES Company announces that the general offices of the Selby Smelting Works have been moved to 444 California street, San Francisco. This is only the second change of headquarters in a period of seventy years. The originators of the business were Kellogg, Hewston & Co., who were established at 416 Montgomery street. Their successors were the San Francisco Assaying & Refining Works, and their successors were the Selby Smelting & Lead Company, which, in 1905, was absorbed by the American Smelters Securities Company, a subsidiary of the American Smelting & Refining Company.

THE morning papers of February 23 contained statements on world affairs by Lord Northcliffe and Mr. Hoover. The contrast between the style of the two utterances marked the difference in the character of the two men. The London publisher is self-conscious and smart; the American statesman is unaffected and wise. Mr. Hoover accepts the work done by the Washington conference as marking "the reconstruction of confidence and hope in the world'', and he points to the sustained rise in international exchange immediately after the adjournment of the Conference as a proof of the intimate connection between the problem of disarmament and our daily business life. The change in the relative values of national currencies ''is normally'', he says, ''the result of the flow of goods or money''. The recent change was due to the ''flow of confidence between men that they were more free from war, with its constant threat of destruction of economic life''.

APPARENTLY the bayonet of the ex-soldier menaces a tender part of the Congressman's anatomy, for the proposed bonus is being discussed with timid glances at the approaching elections. Our own acquaintance with those who served in the Army is that the best of them are entirely adverse to the idea of a bonus; they believe, as we do, that it will do more harm than good; it measures an honorable performance on a commercial basis. Most of the 'boys' will have spent their gift money within a week. The San Francisco Chamber of Commerce is in favor of giving each ex-soldier the right to select at his option the privilege afforded through the national system of reclamation, of aid in home-building, of vocational education, and of provision for paid-up insurance. The bonus scheme will place an intolerable burden upon the country without commensurate benefit to the veterans; it is vicious in principle.

BUCKET-SHOPS are a menace to any community. The New York Stock Exchange recently endeavored to discipline several organizations of this nature by cutting off their wire service. We learn that the indictment of about 20 operators of bucket-shops in the financial district of New York is imminent. It appears that some of the firms advertised to sell certain standard dividend-paying stocks for ''25% down and the balance in weekly installments''. When the payments were nearly completed the victims were told that they could then become partners in a pool, the avowed object of which being to make investments from which large profits could be expected quickly. If the client had no available cash he was invited to allow the stock he had been buying to be used for such purpose. His acquiescence ended disastrously for himself but to the enrichment of the bucket-shop proprietor. There are so many ways in which such gentry can beguile the unwary that these establishments should be kept under strict surveillance. They bring discredit on the mining industry.

WE take pleasure in publishing an article by Mr. Courtenay De Kalb describing the copper deposits of the Sierra Nevada, in Spain. It will be remembered that in 1919 Mr. De Kalb was commissioned by the Department of Commerce to go to Spain for the purpose of reporting upon the mining and metallurgical industries of that country, with a view to collecting information that might be useful to manufacturers and others in the United States. His investigation indicated that there were opportunities for American co-operation in developing the mines of Spain, among others the copper mines he describes in this article. It is necessary for foreigners to operate in the name of Spanish corporations, which are accorded many advantages under the law of the country, and Mr. De Kalb informs us that companies having American shareholders can borrow all the money needed for the exploitation of their properties in Spain at 5%. Great confidence is placed by the Spanish people in American technical men, and American management of mines is accepted as a guarantee of success. This sounds to us a little like the proverbial politeness of the Spanish gentleman, but Mr. De Kalb reports at first-hand, so we are not dealing with mere compliment. Among the technical details of the article we note the suggestion that the siderite tailing if calcined could be utilized as an ore of iron. The tailing would consist of iron carbonate with but little insoluble matter. The nodulizing of finely divided siderite is practised on a large scale in Spain in preparation of the screened material from the carbonate mines, the nodulized iron being exported to England and France.

THE recent sale, for £20,000, of the mining leases, buildings, and plant of the Kalgurli Gold Mines Company, at Kalgoorlie, Western Australia, marks the demise of an important and successful though not spectacular mining enterprise. The company was registered in 1895 to acquire a comparatively small area of 18 acres, the consideration being £80,000, of which £15,000 was paid in cash and the remainder in shares. The total original capital of the company was only £100,000, but this was increased later to £120,000. The ore in the mine was the usual sulpho-telluride common to the Golden Mile, and special treatment was necessary. Roasting and sliming were essential—two refinements that complicated the metallurgy and increased the cost of recovering the gold. The scheme of treatment was not altered to an appreciable extent during the 20 years in which it was in vogue. The ore after preliminary crushing was milled in ball-mills, roasted in Edwards furnaces, mixed with cyanide solution, and slimed in grinding-pans. The pulp, after being thickened, was then agitated in a special type of vat and filtered in Dehne presses. The metallurgic results have been satisfactory in spite of the refractory nature of the ore, over 90% of the gold having been recovered. The payment of dividends commenced as soon as the property became productive, and the dividends have continued without interruption until the present; £1,705,500 has been distributed, or over £14 per £1 share in the 20 years. The assets of the company at the conclusion of operations were such that an amount equivalent to that invested by the original shareholders will be returned to the present owners of the stock. Mr. Robert S. Black, the general manager, in his final report to the directors, congratulates all concerned on the fact that the greater part of the wealth in the Kalgurli mine was won before gold mining in Australia was threatened with extinction in consequence of the effects of the many Arbitration Court awards that have depressed the industry during recent years. The final statistics show that the mine has produced 1,880,000 tons of ore from which bullion valued at £4,580,000 has been extracted. Extensive development work, principally by diamond-drilling, has revealed no new orebodies. The area of the property is small, and exploitation has been thorough. Production was not subject to undue stress during earlier days, so that the underground work has been performed with care. The Kalgurli mine ceases operations after a life of honorable activity that has helped to bring credit to the industry as a whole, and more particularly to Mr. Black, the manager.

Another Pipe-Dream

There has been some discussion recently as to the origin of the saying “I'm from Missouri”, but it proved uninteresting. However, the phrase is one that commends itself to every scientific man, for it is the expression of philosophic agnosticism; it connotes the demand for evidence before any improbable proposition becomes acceptable. We have discussed the synthetic gold of the German chemist and the lake-water gold of the American photographer; we come now to the gold in oil-shale, according to the gospel of a certain A. M. Beam of Colorado. A full account of this stupendous discovery appeared recently in the ‘Montrose Daily Press’, although we may add that we had seen sundry references to it in other newspapers previously. Naturally a discovery so important could hardly be kept secret, especially if vigorously advertised. Indeed, now we come to think of it, we paid our compliments to the inventor and his process in our issue of April 17, 1920, apropos of sundry delirious statements by a Mr. Elihu Palmer, who foreshadowed “the possibilities that the American nation will enjoy soon sufficient wealth in gold and silver to pay the War debt, and much more”. That “much more” assuredly is magnificent, even if not finance! According to the Montrose paper, the discovery “that every shale deposit in the United States carries gold, silver, and platinum values which almost rival the oil yield in worth” was made by Mr. Beam. The “almost” is delicious! At a time when the “worth” of the oil in shale is still doubtful, as a matter of practical economics, it may be true that the “gold, silver, and platinum values” are on a parity with that of the oil itself—the main object of shale exploitation. Ah! but what about the “values”? We are informed, by the Montrose paper, that Mr. Beam in the course of experiments for “the eduction of oil from shales”—a really good word that, ‘eduction’—stumbled upon his epoch-making discovery, but he kept it secret as he was “unwilling to make a formal announcement until one single item in the machinery of his plant had been brought to a state of perfection”. During these experiments, while working on ‘spent’ shale, that is, shale from which the oil had been removed, “he extracted gold in quantities running from $3 to as high as $33 per ton of shale”, also “three ounces of silver to the ton and high platinum values, one reaching the almost unbelievable worth of $88 per ton”. Another delicious “almost”! If we should now average the gold assays, in the manner customary among such ‘inventors’ and ‘discoverers’, we should find that the shale—“practically every shale deposit in the United States”—contains $18 per ton in gold, 1½ ounces of silver, and platinum somewhere between one cent and $88 per ton--say $8.80 per ton! That represents metallic contents worth something like $27 per ton! And, remember, this applies to “practically every shale deposit in the United States”! No wonder the Montrose scribe waxes dithyrambic. After setting aside the value of the oil, ammonium sulphate, and other non-metallic products, “an average ton of raw shale”, the Montrose writer says, “has a value, if Mr. Beam's conclusions are correct, of from $10 to $20 per ton, or more than five times the cost of mining, eduction, and metal recovery”. The “eduction” of the oil is well enough, but how about the education of a scribe that will succumb so easily to a pipe-dream? He continues: “Considering the billions of tons of oil-shale which have been found from New Brunswick to British Columbia and from the Dakotas to Alabama, the total value of these deposits takes on proportions which are so stupendous that one's mind can hardly form an estimate of the wealth they will produce”. True enough, the prospect, as Dr. Samuel Johnson said of a famous brewery that he put up to auction, offers “potentialities of wealth beyond the fondest dreams of avarice”. But if “one's mind” is given to supposing, why not suppose in good style? Here is one for the gentleman at Montrose. If gold be present in sea-water to the modest extent of only one-thirteenth of a grain, or five milligrammes per ton, then the ocean is a stupendous mine, always assuming, as Mr. Beam and the Montrose writer will find it easy to do, that the gold can be extracted at a profit. The ocean, from Spitzbergen to Fernando Po and from Easter Island to the Farallones, has an average depth of 2500 fathoms and contains 400 million cubic miles of water. This is equivalent to 1,837,030,272,000 million tons of water, which, at 5 milligrammes per ton, would represent 10,250 million tons of gold. The present world's output of gold is only about 500 tons per annum. We match our supposition with that of the gentlemen in Colorado! After revelling in such arithmetical exercises it is mere bathos to dwell, as does our Montrose contemporary, on the merits of the retort that Mr. Beam has invented. What is the use of bothering about the oil in the shale, itself a doubtful asset, when the precious metals are so valuable and are needed so much more urgently by a world that is endeavoring to recover from a debauch of paper currency! Another highly interesting feature of Mr. Beam's ‘discovery’ is the fact that he subjects the spent shale “to the ordinary cyanidation process”. As to the platinum, it undergoes “the usual treatment with aqua regia”, which, of course, is so cheap that the cost is negligible. But how does he catch his platinum for subjection to the double acids? That is a much more interesting point. Does he dissolve all the spent shale, after cyanidation, in aqua regia? These, of course, are petty matters, but they appear to need clarification.

"The basic principle", we are informed, "is the subjection of the shale to a high and constant heat, which drives off the carbon which in nature is the element that holds the metals in their matrix". Here we resign. These 'delirious trimmings' of science are too much for us. It is said that Nature abhors a vacuum, so our simple mind protests against these excursions into the inimitable inane.

Industry and the Technical Paper

Science will never develop its greatest usefulness to society so long as it is translated only into technology; it must find expression also in sociology, in economics, and in the management of industry. This will call for a broader training and more diverse talents among scientists, some of whom will continue to enrich the records of research while others will develop managerial ability or technical superiority, or acquire skill in the practical application of economics and sociology. These comments summarize the features of an address recently delivered before the Chicago section of the American Chemical Society by Mr. H. C. Parmelee, the editor of 'Chemical and Metallurgical Engineering' and a former president of the Colorado School of Mines. In the same way, says Mr. Parmelee, the technical paper must supplement its technology with the economics and the business of industry. The ultimate aim—for the individual as well as for the industrial press—will be the perfection of our industrial processes, the avoidance of waste, and the stabilizing of labor and production, so that the standard of living may be raised and human happiness may be increased. To such an end is the modern technical paper dedicated. Mr. Parmelee states that industrial publishing has reached its highest development in the United States, where more than 1200 periodicals are now devoted to industry. The growth of this publishing business has been coincident with industrial expansion. The first industrial paper of which we have record was founded in 1846. During the next decade two more were published. Here we may interpolate that the 'Mining and Scientific Press' was founded in 1860. However, no great impetus was given to the business until after the Civil War, when the country went through a period of intensive growth and development. Industries of all kinds invited leadership, and industrial magazines were started to point the way. From one paper in 1846, three in 1856, and 25 in 1869, the number grew to 800 by the end of the century and to well over 1200 at the present time. An important group of the industrial press comprises what are known as technical papers, which deal with the technology of industry and with the application of science and engineering principles to the problems of production and management. But, adds Mr. Parmelee, the technical paper can no longer fulfill its function if it merely discusses processes and products; it must also be the business exponent and mouthpiece of the industry, reflecting its needs and guiding its interests. It must become an integral part of the industry in question; it must be of the industry as well as for it. The perception of this new responsibility was quickened during and immediately after the War, when economic and industrial problems had to be faced that far transcended in importance the problems of technology. There was need for some public agency to inform the Government of the problems of industry, and to interpret to industry the intentions and acts of the Government. Industry found itself without a mouthpiece, which was then supplied by the technical press. In the matter of new development there was the constant necessity of keeping the economic and industrial as well as the technical aspect clearly in mind; for this reason the technical press has brought to industry vital statistics in regard to consumption and production, imports and exports. It has featured the importance of markets for new products and sources for raw materials. It has acquainted industry with the activities of the Government, sometimes approvingly, sometimes disapprovingly.

Mr. Parmelee emphasizes the fact that the technical paper cannot accomplish its purpose without close personal contact with the industry it represents. Travel by the editors is essential to successful industrial journalism. Plants must be visited and processes described in order that text-book fundamentals may be simplified and brought up to date with practical details of current operation. Thus it is that the industrial editor is enabled to see his industry as a whole and to judge matters impartially. The modern technical paper cannot be edited from the desk; it must show a familiarity with industry itself that can only be acquired by personal contact. It is still a magazine of information pertinent to the technology of the industry it serves. This is an important function that cannot be subordinated without jeopardizing industrial progress; but the modern technical paper also treats of the economics of the industry, informing its readers on the relations of the tariff, finance, and other legislation to business. It is the newspaper of the industry; it contains personal and business intelligence on which its readers should be informed. Market movements and trade tendencies are reflected in reports gathered at first-hand. Finally, and this is a point in which we are in whole-hearted agreement with Mr. Parmelee, the modern technical paper is a magazine of opinion—the mouthpiece of the industry; and herein lies one of the distinctive differences between it and the magazine of the technical society. The editorial independence of the industrial paper, its freedom from domination by any interest, or allegiance to any group, make it possible to adopt policies for the good of the industry as a whole. This freedom of expression is denied the publication of the technical society, which must serve primarily its own members; editorial opinion cannot be expressed with freedom on a wide variety of topics, for the evident reason that the magazine must speak for the society. An independent technical paper labors under no such handicap, being bound only to serve the best interests of the industry, whether people agree with it or not. We are glad to see such a fearless expression of opinion from New York; and we congratulate Mr. Parmelee on a scholarly presentation of the facts.

DISCUSSION

A Definition of Engineering

The Editor:

Sir—Mr. Parsons' definition of engineering on which he invites criticism and on which he writes in the issues of December 17, 1921, and February 11, 1922, does not seem faultless. In the first place it is too broad and might well be called a definition of 'the planning of useful work' as well as of 'engineering', for it covers pretty much the same field. It certainly includes the case of a prospector who sits in his cabin and contemplates a pair of pants with a hole in the seat and devises a plan and contrives a method for the creation of something having material value for mankind (that is, the prospector) by utilizing the forces of nature and human labor by applying a patch. Although this comes under Mr. Parsons' definition, I doubt if the majority of your readers would consider this engineering.

Secondly, the definition is too narrow, for planning and devising is not all of the work of the engineer; the carrying out of work and its supervision is a most important part of engineering. As given by Mr. Parsons, the prospector could only devise and plan his patch, but could not put it on.

Mr. Parsons states that he specifically and explicitly does not attempt to define 'engineer', but he certainly implicitly defines the term, and his definition is easily made out by a slight change in his wording, thus: An engineer is one who devises plans and contrives means and methods for the creation of something having material value to mankind, by the utilization of machines, commodities, human labor, and the forces of nature.

The negative action of Alfred P. Flinn and associates referred to by P. B. McDonald in your issue of January 14, seems worthy of imitation: their decision was that they discouraged any attempt to define 'engineer', and that decision seems reasonable.

The following remarks of others on this subject are worth repeating. They are taken from an article on 'Ethics and Industry.'* J. Swinburne, past-president of the Institute of Electrical Engineers, London, said, in an address to students: "In the charter of the Institution of Civil Engineers the engineer is defined as 'Directing the great sources of power in Nature for the use and convenience of Man'. With all respect I would humbly suggest that it is bad. . . An American definition is much better: 'An engineer is a man who can do for one dollar what any fool can do for two' ". Mr. Swinburne further stated: "A business-man may have knowledge of the ways of nature, but he has no knowledge of the ways of man, a knowledge which is infinitely more difficult to acquire, and infinitely more difficult to employ well".

Palo Alto, February 14. W. H. Shockley.

The Editor:

Sir—Mr. Shockley has kindly permitted me to see his letter apropos of the definition of engineering, so that I might discuss his criticism in the same issue as that in which his appears. Mr. Shockley's first point, that the definition is too broad, is well taken; in fact, I made the same criticism when I launched the now much-buffeted suggestion in your issue of December 17. In the course of the argument I propounded the question, "How shall we eliminate the tailor?" That is one of the shortcomings for the correction of which I seek assistance.

Mr. Shockley's second point, that the definition is too narrow, is also well taken, although anyone who read my first letter will see that my idea coincides exactly with Mr. Shockley's. For instance, I said, "I am inclined to take the view that accomplishment is as essentially a part of engineering as is conception". Again I say, "Even though it be conceded [and the implication is clear that I do not concede] the rôle of the engineer is to plan and not to execute . . ."

I endeavored to distinguish the direction or supervision of the execution from the actual manual labor of execution; I used the word "creation" in an effort to imply the idea of 'execution'. I am inclined to agree, however, that an amendment may well be made and I submit the following version, without feeling any assurance that in an effort to escape from one difficulty I do not get myself into a more serious one:

"Engineering is the contriving of designs, means, and methods, and the supervising of the execution of plans, for the creation of something having material value to mankind by the utilization of machines, commodities, human labor, and the forces of nature."

My only reason for side-stepping 'engineer' in order to address myself to 'engineering' was explained in the original letter: that someone would pick out John Doe or Richard Rowe, who was admittedly an engineer, but who confined his activities to one special phase of engineering work, and declare that he did not actually create anything and that therefore the definition was as bad as it could be. My thought was that the ultimate purpose of the project with which every engineer is connected is the creation of something of material value. Apropos of the dictum (if it be that) of "Mr. Alfred P. Flynn and his associates", I can see no harm in speculation and discussion even if no definition of real merit is evolved, and even if no particular purpose is served other than mental stimulation. If we were to discourage thinking about perplexing subjects we would miss much that is interesting in this world of ours.

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*'E. & M. J.', Dec. 22, 1904, p. 280.

History records the fact that Justice Storey of the U. S. Supreme Court, before he was elevated to the highest tribunal, was invited to formulate the Federal Statute regarding bankruptcy. He determined to write a law that was as nearly perfect as a law could be; it was to be the acme of clarity and precision; there was to be no possibility of diverging interpretations or constructions. The law was written and re-written; other jurists were consulted and the statute as finally passed by Congress was pronounced by many to be as free from vagueness and ambiguity as human intelligence could make it. Some years later, when Judge Storey had become a Justice of the Supreme Court, a case came up for oral argument in which was involved this particular statute regarding bankruptcy. Being the author of the law, Justice Storey felt that he was in an exceptionally fortunate position to interpret it as all good laws should be, but sometimes are not, interpreted. Counsel for one of the litigants was a particularly learned lawyer and a brilliant orator. He addressed the Court for an hour, the subject of his argument being Justice Storey's pet statute. There are probably no eye-witnesses to spoil this tale now, so I give the substance of the Judge's comment as stated to me. He declared that he had seen many poor laws, but that after listening to the diatribe of Daniel Webster for an hour, he was convinced that the Federal Bankruptcy Statute was the worst; it was a mere jumble of obscure, unintelligible, contradictory, inconsistent, equivocal, and ambiguous statements.

I hasten to disown any intention of comparing myself with the Justice, or the fruits of my efforts to define engineering with the statute that he wrote; I merely relate the incident to emphasize the fact that if a man so wise and skillful was unable, first, to use words so as to say what he meant, and, second, to frame a law that would suit Daniel Webster, I should not be chagrined at being unable to say what I mean or to frame a definition that suits Mr. Shockley.

A. B. Parsons.

San Francisco, February 18.

Errors Latent in Mine-Sampling

The Editor:

Sir—I have read the reprint of Mr. Morton Webber's well-known article on errors latent in the sampling of mines. This is a subject that will ever be of the greatest importance, and it is a pleasure to read an article so full of ripe experience and so clearly expressed.

Some points occurred to me that seem worthy of being emphasized. The first is the example of the Aurora fiasco. Here is an excellent case illustrating that it is better to buy a mine on time-payments rather than at a less sum for cash. In Mr. Webber's examination of the mine he noticed that certain points indicated a possible weakness in the value of the property and he offered $100,000 more than the selling price, which was evidently about $1,000,000. This additional sum was to allow additional time to do certain work to clear up this point of weakness. This is an excellent example of maturity of thought or the application of science to business requirements. Examples such as these should be incorporated in our college textbooks, not that they will be easily clear to students but at the earliest date the young engineer will become a little more saturated with the fact that mine-valuing is a business proposition and not an academic science. Mr. Webber offered $100,000 more than the asking price as an insurance on $1,000,000. If his suspicions were well founded, the principal would be saved. If not, an extra 10% on the purchase price would be of little moment; for a mine that is not worth $1,100,000 is not worth $1,000,000, as the profit to be demanded in mining must be considerable to justify the risk. Mr. Webber's suggestion is to the point that when these reasonable proposals are refused by a seller it is advisable "to profit by the vendor's inside knowledge of his own mine and drop the business".

Another point that occurs to me is that it is satisfactory to get some examples of mines that actually stope more than they sample. Mr. Webber says they are in the minority but that they do exist. The examples he quotes from his own experience are only copper deposits. It would be much to the point if Mr. Webber or some other authority could give some actual examples of gold or silver mines. We hear of them, but I am personally in doubt as to their existence.

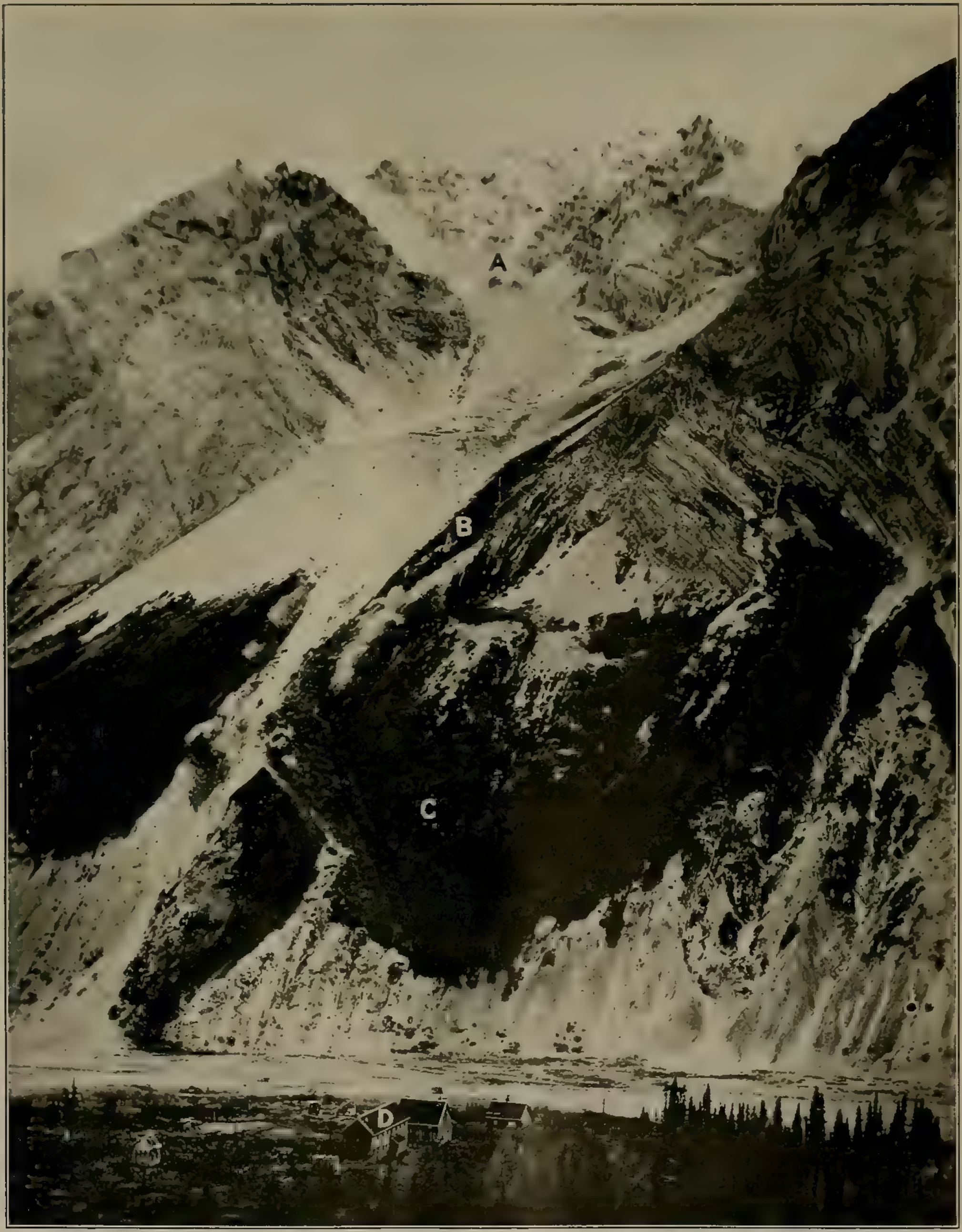
Another point made in Mr. Webber's article is the suggestion that if some means could be devised to wash the dirt off the faces underground before sampling is commenced many mines would look very different. One of your contributors states that faces should always be washed before sampling. Either he or I misunderstand Mr. Webber. The cleaning of the particular faces to be sampled is elementary and done by all of us. I understand Mr. Webber's statement as an abstraction referring to an ideal, namely, if the entire workings could be thoroughly washed an ocular impression could be obtained and in many cases we would not start sampling at all.

These specialistic articles are a clear gain to the technology of the profession and it is a pity that we do not have more of them.

H. E. Black.

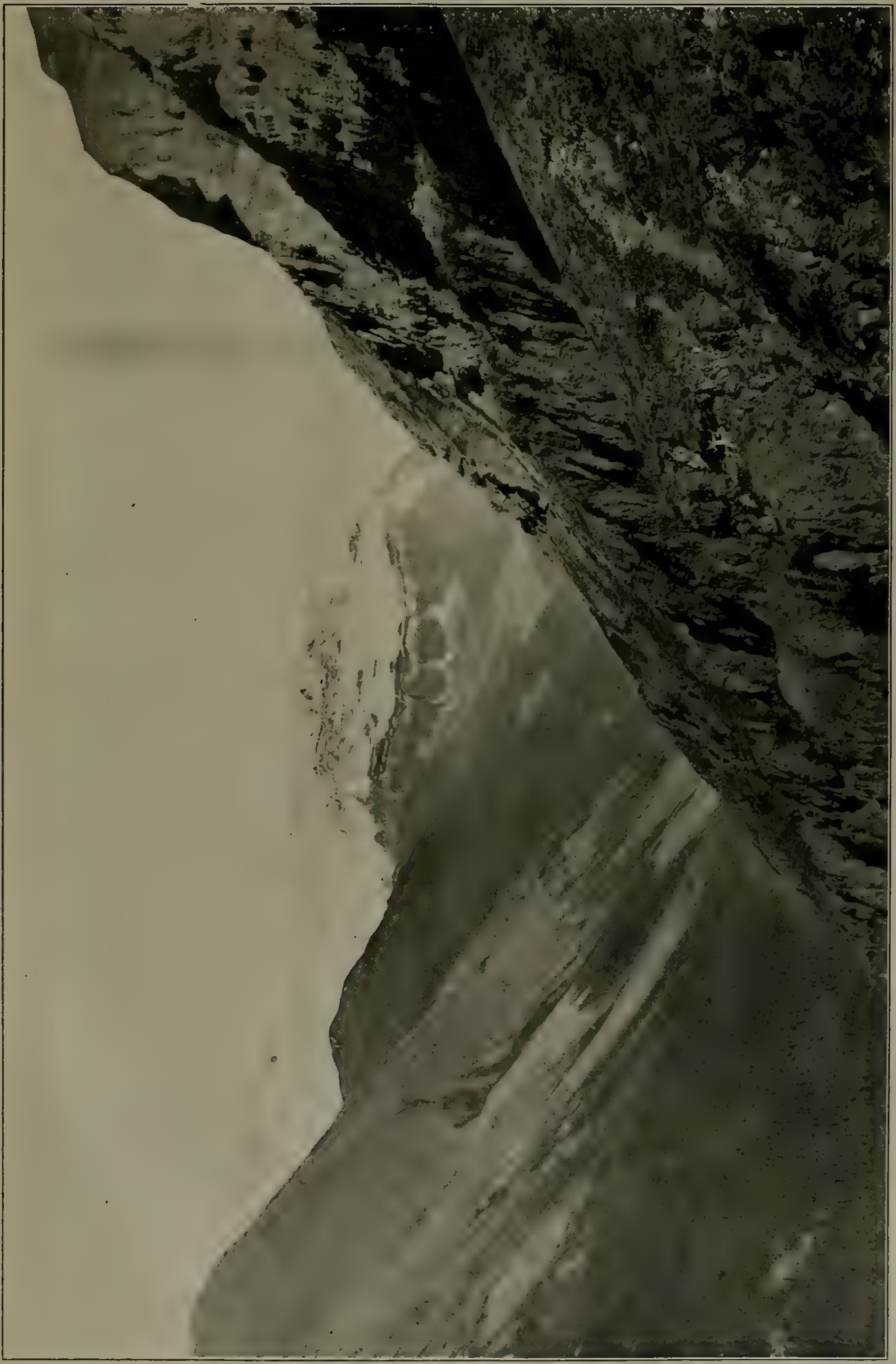
Chicago, February 2.

The Chuling Mining Co., which is working a lead mine in the Swatow district, in China, recently made its first shipment of lead, states a consular report. The present capacity of the furnaces is three short tons per day. It is proposed to double the furnace capacity at an early date. A high-grade soft lead, running between 99.97 and 99.98% pure, is produced. It is shipped in slabs weighing 140 'catties' (about 187 lb.) each. A ready market for this product is found in South China.



MOTHER LODE COALITION MINES, IN THE COPPER RIVER DISTRICT OF ALASKA

A. Adit. B C. Tramway. D. Terminal and camp.



Looking up McCarthy Creek, in the Copper River District, Alaska

PEAK OF MULHACÉN, SPAIN

THE ALHAMBRA, FROM THE SILLA DEL MORO. GRANADA IN THE DISTANCE

HYDRO-ELECTRIC PLANT IN THE VALLEY OF THE GENIL, SPAIN

THE PLAZA IN THE MOUNTAIN TOWN OF GUEJAR

ENGLISH PLACER MINE AT LANCHA DE CENE, ABOVE GRANADA

Copper in the Sierra Nevada, Spain

By Courtenay De Kalb

*In the Sierra Nevada, near the cluster of three lofty peaks that form the highest eminences on the Iberian Peninsula, namely, Mulhacén, La Veleta, and Alcazaba, is a series of copper veins that has attracted attention at frequent intervals since the times of the Romans, if not before. The Spanish geologists have correctly attributed to this mineralized area the origin of the gold placers that first drew the attention of mankind to the district of Granada. The founding of the original city was due to the gold-bearing gravels of the Darro and the Genil, which were worked by the Phœnicians. Traditionally they contributed to Solomon's stores of gold. The richest accumulation of these auriferous deposits seems to have been in the fan of the Darro just below the hill on which stands the beautiful Alhambra. Even today, after freshets have passed over and stirred the gravels anew, it is no uncommon thing for the urchins playing in the arroyo to find *pepitas,* or small nuggets of gold, in the gravel banks along the Darro. Gold 'colors' can be obtained also by panning the gravels along the river Genil. A short distance above Granada, in the valley of the Genil, at the old Moorish palace of Lancha de Cene (at Cene de la Vega) is the Mina del Zapatero, a gravel mine which an English company undertook to work more than 20 years ago. The accompanying view shows that a serious effort was made, judging by the size of the dumps. Only a portion of these is visible in the photograph. They are from 60 to 90 ft. high, and more than 500 ft. long. I have not been able to obtain data as to the richness of these gravels. Current gossip assigns to them a value equivalent to 10 cents per cubic yard, which may be heavily discounted, else it is hard to understand why the English owners should have ceased operations. The property in some respects is well situated, being on the level of what is called the *acequia gorda,* the largest and highest of the great aqueducts built by the Moors to distribute the unfailing waters of the Genil over the exquisite and fertile valley between the mountains and Granada. On the other hand, the fouling of the waters, even to a slight extent, by slime coming from the treatment of the gravels, would be a serious obstacle. It would ruin the water for irrigation unless an elaborate system were introduced for settling, the cost of which would absorb a great portion of the recoverable gold-value of the gravels.

The occurrence of the copper near the head-waters of the Genil is of such interest, and the deposits have been so little studied, that it appears necessary for a correct understanding of their character and importance to explain the salient features of the geology of the region. The Sierra Nevada was formed during Miocene time. The lower Miocene was the period when folding and faulting of the strata began. The emergence continued throughout the Miocene and was prolonged through the Pliocene. Elevations sufficient to inaugurate rapid erosion were reached in the period referred to the lower part of the upper Miocene. It was at this time that the auriferous gravels of Cene de la Vega began to be deposited, the subsequent erosion of which, with consequent re-concentration of the gold, produced the gold-placers that were worked at the dawn of history in the valley of the Genil.

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The axis of the anticline that constitutes the high range lies between the pinnacle of La Veleta and the twin peaks of Mulhacén and Alcazaba, in the steep arroyo known as Valdeinfierno. The crest of the anticline has been deeply dissected by erosion, which has been increasingly energetic since the denudation of the forests of the Sierra. Today no more than scattered remnants of oak, maple, and pine remain; and at the present rate of cutting for charcoal-burning the mountaineers estimate that the timber will be completely exhausted in about 20 years. Notwithstanding this, snow remains in great banks around the summits throughout the year, and water is extremely abundant at all seasons, the torrents being greatly swollen during the months of March, April, and May. The result of such rapid erosion as is active here has been to cut down through the slates to a basic intrusive that had invaded the axis of the anticline, this rock being classified in the field as diabase. At a distance of about four miles toward the north, down the river Genil (which stream has its source on the twin peaks of Mulhacén and Alcazaba, in the arroyos called Bacares and Alcazaba), is a large mass of serpentine embedded in the slates. This outcrop is found in the Barranco de San Juan, and is widely celebrated on account of the beauty of the stone. This probably bears some relation to the basic intrusive that is seen in Valdeinfierno. Just above the point where the Barranco de San Juan joins the Genil the trail is crossed by a dike of basic rock about 40 ft. wide, which is accompanied, on the south side, by a wide zone that has been highly altered, and on the outcrop displays a deep red color from oxide of iron. Similar signs of mineralization are abundant between this dike and the Barranco de San Juan. The most important mineralization, so far as known, however, is in the upper part of the valley of the Genil, between La Veleta and Mulhacén.

It is interesting to find ore deposits associated with the basic eruptives here, as elsewhere in Spain. Moreover, the ore formed consists of carbonate of iron, in this instance associated with considerable quantities of copper sulphide, in the form of disseminated chalcopyrite.

The great mass of the Sierra Nevada consists of satiny silicious slates, often feldspathic, and in part epidotized. The satiny sheen is due to sericitization. They have been generally ascribed to what the European geologists call the Primitive Age, but the Commission of the Academy of Sciences of Paris in its report on the Earthquake of Andalucia† (1885) questions this conclusion, and points out that they are undoubtedly metamorphosed sedimentary rocks, which, however, are pre-Cambrian. The quartz grains are distinct, and are embedded in a complex of biotite and orthoclase. An idealized cross-section down the valley of the Genil from Mt. Mulhacén to Granada is given on page 291, the altitudes in which correspond to the bed of the river Genil. The mountain walls on each side of the canyon rise several thousand feet higher at all points from Güejar to Valdeinfierno, from which arroyo the ascent is abrupt to the summit of Mulhacén.

This highest group of mountains in the Sierra Nevada stands on a fault-block of large dimensions, one side of which reaches the Mediterranean at Motril and the other at Cabo de Gata, near Almeria, the direction of the bounding planes on the east and west sides being approximately N. 60° W. The entire block has been under compression, producing throughout it a series of parallel faults, which are also approximately parallel to these bounding planes of the block. It is along these faults, in the vicinity of La Veleta and Mulhacén, in what may be called the Bacares district on account of the principal mine, that the deposits of iron carbonate with chalcopyrite occur. The most abundant mineralization has been at no great distance from the basic dike in the Valdeinfierno, and the largest deposit that I saw, at the Bacares mine, lies directly athwart the crest of the anticline. Most of the deposits are narrow, ranging from a mere seam to widths of several feet, but at Bacares the width is from 16 to 30 feet.

With this introductory note it will be possible to appreciate better the discussion of the veins themselves. It must be understood that I was unable, in the brief time at my disposal, to make an examination of these properties such as would be necessary with a view to determining with certainty the advisability of actual development. My work was no more than a reconnaissance; but it revealed possibilities of such great interest that I do not hesitate to recommend a detailed investigation by engineers representing capital. The region has been prospected, and attempts to treat the ore have been made, at intervals, for a long period. Tunnels on the veins are seen at many places, with remains of ancient structures, and piles of slag. Near the junction of the Genil with the Valdeinfierno at La Fábrica Real, are evidences of considerable metallurgic activity in ancient times. The tradition among the dwellers of this region is that these works were maintained by the Moors.

Several kilometres below Valdeinfierno, at the junction of the Genil with the arroyo de Guarnón, which drains directly from the snow-field under the crest of La Veleta, is a group of stone houses and numerous ruined structures, said to represent comparatively recent efforts by Belgians to utilize these copper deposits. There are several tunnels at this point, most of which are inaccessible. The site is one of the land-marks of the region, and is known as La Estrella. Its altitude is variously estimated from 5000 to 5400 ft. above the sea. Just above the houses at La Estrella a strong lode crosses the Guarnón and, extending toward the south-east, crosses the Genil at a distance of about one kilometre, at the ruin of a large house called La Casa de la Justicia, which is of comparatively modern construction. At the latter point the lode shows no evidence of mineralization on the surface, but the cliff-face has been highly polished and striated, and the breaking down of blocks from this wall reveal brilliant slickensides on a surface 15 ft. high by 40 ft. long. The dip here is 85° toward the east, which is not in accord with the usual dip of the veins in this region, the customary position being toward the W. S.W. There is a tunnel, now inaccessible, following this wall, but no ore appears on the dump.

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†Translation published by the Comisión del Mapa Geológico de España, under the title 'Estudios Referentes al Terremoto de Andalucía, Ocurrido en 25 de Diciembre de 1884', Madrid, 1890-'93.

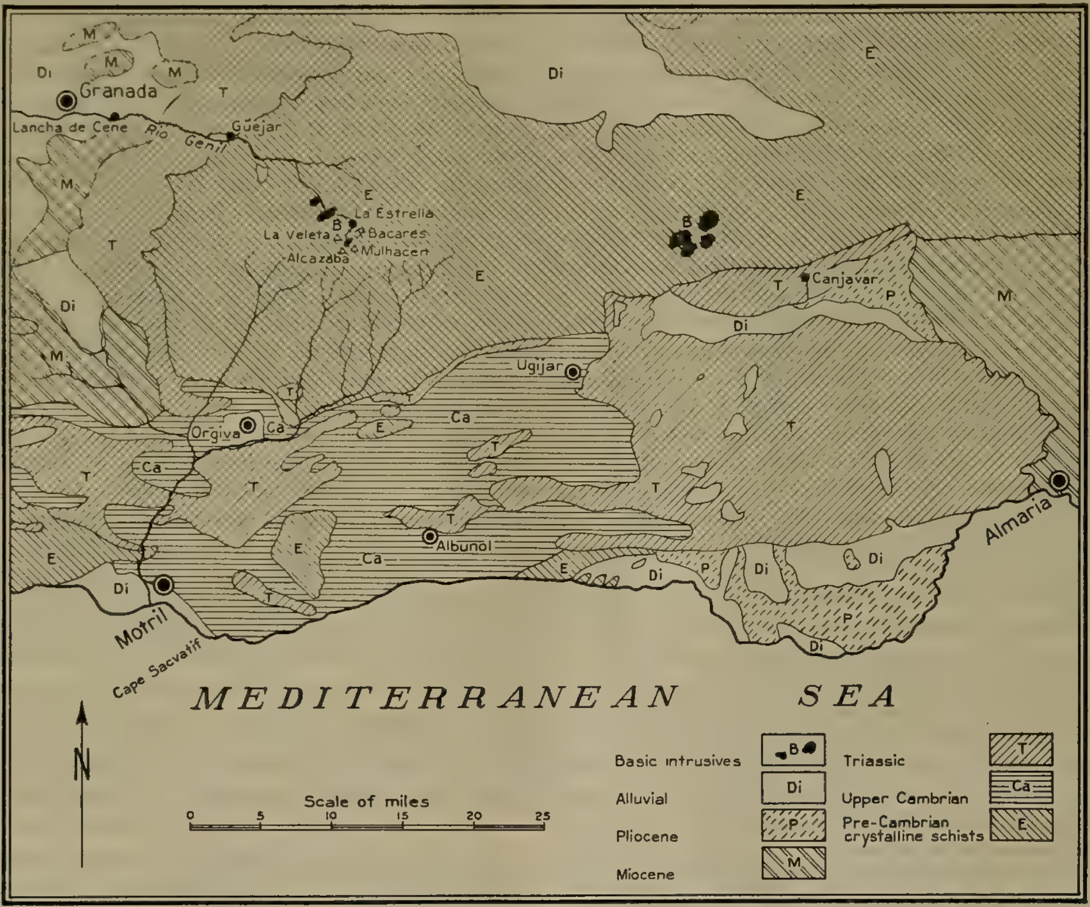


FIG. 1. GEOLOGICAL SKETCH-MAP OF SIERRA NEVADA-GRANADA DISTRICT, SPAIN

This vein, however, where it crosses the Guarnón, is much more promising. There is a zone 40 ft. wide, which forms a marked depression on the surface, where the outcrop consists of soft material, greatly decomposed, and stained with iron oxide. Several tunnels, now badly caved, have been driven into this. One of these, after passing through slate, only slightly decomposed, for about 60 ft., enters a sericitized zone that is extremely soft, containing masses of what was originally iron carbonate, now largely oxidized, and containing much chalcopyrite, with stains of copper carbonates. A pile of ore, consisting of several tons, lay on the dump beside the tunnel-mouth. Judging by the eye this pile would contain more than 4% copper. The ground was so 'heavy', in the miner's use of that term, that no attempt had been made to explore the width of the vein underground. It was certainly most promising in appearance. On the opposite side of the steep arroyo of the Guarnón a depression, about 4 ft. wide, makes a gash in the hard rocks up the side of the mountain for more than a thousand feet. A tunnel had been driven about 30 ft. into this, revealing 7 ft. of ore that would assay about 3% copper. The walls are slickensided, and at this point are widening rapidly, as seen in the section, Fig. 3, page 297.

This vein, known locally as the Rascal, would appear to be worthy of investigation. There is evidently an ore-shoot of considerable dimensions on the south-east side of the arroyo. The fact that the vein is widening in depth on the north-west side of the canyon, and that it appears to possess large dimensions where prospected on the south-east side, the existence there of large masses of iron carbonate having primary sulphide (chalcopyrite) disseminated through it, and the further fact that the sericitized masses are blackened in many places with sooty chalcocite, arouse interest in the possibilities of more thorough investigation. From the heights above the Casa de la Justicia the depression made by this vein can be seen distinctly for more than a mile and to an altitude of 3000 ft. above the point where it crosses the

Genil. It is characterized by brilliant-red discolorations on the outcrop at frequent intervals, similar to the one over the large indicated ore-shoot in the arroyo de Guarnón. Proceeding up the Guarnón from Estrella toward the lofty peak of La Veleta, numerous fissures are seen crossing the arroyo, on some of which prospecting has been done. On the dumps in many instances were seen the characteristic piles of iron carbonate (turned brown and sometimes wine-colored from the commencement of oxidation on exposure) with chalcopyrite in small grains and specks disseminated through it.

Toward the head of the arroyo, about a mile from the summit of La Veleta, is another strong vein, called the Campanario. It appears in the form of a gash extending diagonally up the precipitous cliffs that here constitute the north-west wall of the deep canyon. With poor judgment the miners have done their prospecting at a great height on the cliff-face instead of driving a tunnel at a low level where, if ore were found, they would have backs of sufficient importance for economic operation. A drift on the vein near the bottom, about 400 ft. below the tunnel in the belfry (*campanario*) might have proved commercially profitable. The tunnels are reached by a narrow goat-path following the vein, the erosion of which has left a ledge that gives the impression of a gash when seen from below. The cliff faces S. S. E., and the dip of the slates is N. N. W. The vein dips W. S. W. about 50°. The dip of the vein, accordingly, is nearly at right angles to the dip of the slates. An accurate average dip of the vein could not be obtained from the relatively small exposures made in the tunnels. The vein averages about 12 in. wide, expanding at places to 3 ft. At the wider points the ore is mixed with a larger proportion of altered country rock. The gangue consists of quartz and siderite (carbonate of iron) with bunches and seams of limonite on the outcrop, resulting from the oxidation of pyrite and chalcopyrite. There is also a great deal of sericite, which is a characteristic accompaniment of the veins in the district. Copper carbonates are in evidence at many places on the outcrop of the Campanario vein. The first tunnel is at an altitude of 300 ft. from the base of the cliff. A niche had been cut on which was piled about 12 tons of selected ore, that might assay 12 to 15% copper. The vein in the tunnel was persistent but narrow, consisting of carbonate of iron, considerably oxidized, associated with ashen colored sericitized material, containing both chalcopyrite and sooty chalcocite. A hundred feet farther up the cliff-base was a tunnel 80 ft. long, revealing similar vein-matter maintaining more or less the same width that it showed in the lower tunnel. About 20 tons of ore was piled up near the tunnel-mouth, and it was even richer in chalcopyrite than that below, but contained less chalcocite.

Another vein, said to be much larger than this, crosses the head of the Arroyo de Guarnón, just below the snow-bank under the crest of La Veleta, but time was lacking to visit it. This is called the Veta Grande. On the side of the Valdeinfierno, which is the next arroyo to Guarnón toward the south-east, the Veta Grande is said to equal, in size and richness, the Bacares vein which is presently to be described. The trail to Bacares passes the Casa de la Justicia, and has been blasted out of the cliff face on the right bank of the Genil to a height of 800 ft. or more. Thence it zig-zags up the steep slope above the precipitous canyon-wall, crossing a wide and dangerous rock-slide, passes a terraced garden of the mountaineers, and finally comes to the dump of the Era or Threshing-floor mine. The outcrop was indistinct, but a considerable amount of work had been done, judging by the size of the dump. A pile of the characteristic siderite ore, with disseminated chalcopyrite, lay on the dump. The workings were inaccessible. From this point the trail gained altitude with great rapidity, detouring now and again toward the heads of short deep arroyos, but always swinging back to the cliffs that constitute the canyon-walls. It was a four-hour climb from the Casa de la Justicia, at an altitude of about 5400 ft. to the Bacares mine, which is approximately 10,000 ft. above the sea. The vein outcrops along the side of a ridge that swings in a curve toward the south-southwest where it joins the flank of the great peak of Mulhacén. The top of this ridge is perhaps 600 to 800 ft. higher than the outcrop, and the slopes at this altitude are gentle. There is an abundance of room for the construction of buildings and miners' homes. The hills in August, at the time of my visit, were sparsely covered with grass, springs were abundant, and herds of cattle were grazing.

From this point the view extended to the Vega of Granada, and to the great mountains of Jaén in the north-east. Westward, across the upper valley of the Genil, the rim of serrated mountains was seen to be continuous from the peaks of Mulhacén and Alcazaba to La Veleta. The upper extension of the Valdeinfierno follows almost exactly the axis of the anticline, and the dip of the slates in opposite directions on either side of this arroyo is most conspicuous. On the north side they dip north-west, at an angle of less than 45°, whereas southward of the crest they dip to the south-east at steeper angles, with several faults. On one of these blocks the strata are crumpled, and highly stained with iron oxide, followed by a zone having a distinct greenish color. Elsewhere the usual dull-gray hue of the slates prevails.

The outcrop of the Bacares vein is nearly horizontal, and has been worked at many places. There are five principal quarries, or open-cuts, in a distance of 1200 ft. The dip of the vein is approximately in the same direction as the slope of the ridge, that is, toward the W. S. W., but much steeper. It was impossible to obtain the true dip as there was no shaft giving any considerable exposure of wall. The average of six observations was 70°S., 65°W., and the width varied from 16 to 30 ft. A gossan of limonite and hematite had originally covered the vein deeply at places, remnants of considerable size still being found. The ore is remarkably free from gangue, consisting mainly of massive siderite, containing chalcopyrite disseminated throughout. Occasionally masses of chalcopyrite from several inches to a foot in diameter are found, but for the most part the grains are interspersed through the crystalline siderite, the crystals of these two minerals interfering with each other, and manifestly having been formed contemporaneously. The piles of ore stacked on the dumps aggregate certainly more than 5000 tons. The ore evidently had been hand-sorted in order to select chalcopyrite that was rich enough to be smelted. This work was done 50 years or more ago, the ore being hauled on mule-back down a steep trail to the old works called Fábrica Real, on the edge of a relatively broad and level space just above the mouth of Valdeinfierno. It is evident that too much of the lower-grade material had to be handled to admit of operating in this manner at a profit.

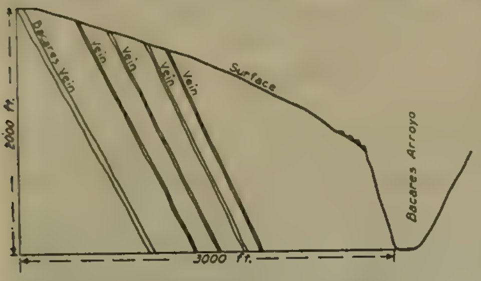


FIG. 2. CROSS-SECTION UP THE VALLEY OF THE GENIL FROM GRANADA TO MULHACÉN

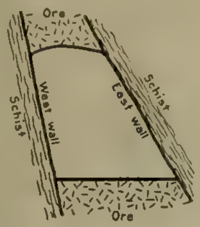


FIG. 3. RASCAL VEIN

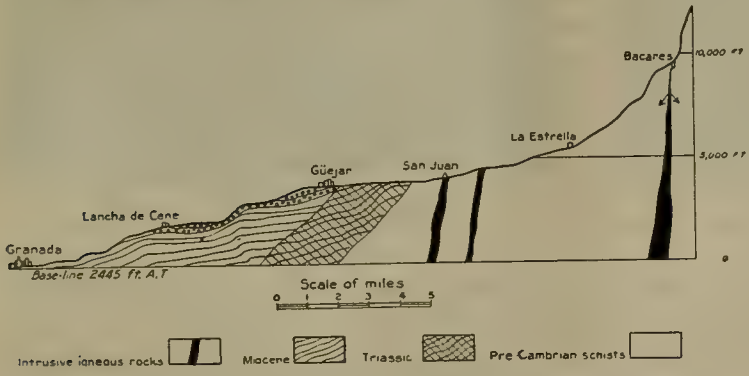


FIG. 4. BACARES VEIN. THE TWO ARROWS INDICATE OPPOSITE DIPS ON THE SIDES OF THE CLOSED FOLD

At another period, about 1850 or earlier, a circular, water-jacket furnace was erected near Güejar de la Sierra for smelting these ores, and a trail following the ridges was broken from Güejar to Bacares, which is said to be easier than the trail up the canyon. This would seem not at all improbable. In like manner the *neveros,* who transport glacial ice from La Veleta to Granada by mule trains, follow the ridge-road, and they make the round trip of 50 kilometres (31 miles) in one day of 14 hours. The ore in the dumps, representing that which had been sorted for recovery of the richer portions, I grab-sampled by taking pieces of blocks, in a great number of cases sledging the blocks open so as to obtain pieces from the interior. Selection of richer pieces was carefully avoided. This sample, corresponding to nearly 5000 tons, contained 2.5% copper. The idea will at once occur to a metallurgist that an opportunity is here presented to effect a separation of the copper, and to base the operation of the mine upon this metal; the tailing, after concentration of the copper, would constitute a by-product that could be sold as an iron ore. This tailing, upon being nodulized, would constitute an acceptable material for the iron-furnace, following current practice at many of the greatest iron mines in Spain, where carbonate ores are treated by calcination.

A report was made upon these deposits in 1894 by L. Legrand, a French mining engineer, some reference to which may be useful, as he spent several months in this study, and was able to inspect most of the veins in considerable detail. He asserts that diorites have not been found on the water-shed of the Genil, but if he means that no igneous rocks have been injected through the slates he is in error, as my observations and my specimens demonstrate. He was apparently not aware of the existence of the great fault-block on which stand the loftiest peaks of the Sierra Nevada, and consequently he knew nothing of the relation of the movement that formed them to the fissures that produced favorable conditions for ore deposition within the block, but he points out that the system of parallel faults is found, not only in this part of the valley of the Genil, but that it embraces the entire mountain range, which is significant.

He recognized that the veins were formed by replacement of the slates, and he identified the following list of metalliferous minerals: chalcopyrite, tetrahedrite, malachite, melanconite, stibnite, pyrite, and native copper. I did not see any tetrahedrite, and it is certain that he mistook chalcocite for melanconite. He calls attention to the fact that the iron in the veins exists almost wholly as carbonite (siderite). He states that in some veins the copper is present originally altogether as chalcopyrite, and in other veins as tetrahedrite. The width of the veins is said to be 0.5 to 8 metres (18 in. to 26.25 ft.), which my observations confirm. He insists upon the ore-formation being due to hydrothermal solutions, for which the evidence appears indubitable. He also affirms that the richness of the veins varies with their inclination, those that stand most nearly vertical being the more highly mineralized.

Concerning the Bacares vein, which he calls La Andreina, he says the outcrop is one of the highest in the district, but he assigns to it an altitude of only 2470 m. (8101 ft.), which is much too low. He explains that the vein-outcrop is on the slope of a ridge forming one wall of the river Bacares (the highest fork of the Genil), the slope being more gentle than at any other point in the upper canyon of the Genil, and that the outcrop of the Andreina vein is the largest of any in the region. According to his observations the strike is north 36° west, with a dip of 45° to the south-west, and with an average width of 5 m. (16.4 ft.). Legrand also says that barite is present in places, but that he saw no tetrahedrite. He assumes that the silver is present only through the existence of that mineral and his samples show only a trace of the white metal. The average copper content, however, he found to be 3.79%. This indicates that, before sorting, the ore may have been richer than the piles which I was able to sample.

Other veins described by Legrand are the following:

Mina California, or La Villuda (Viuda), approximately parallel with the Bacares vein, at a slightly lower level, crossing the Barranco del Aceral, which is the next gulch northerly from Bacares. The dip is S. 70° W., and the width 0.6 m. (2 ft.). The character of the ore is similar to that in the Bacares lode.

Mina de Cuatro Hermanos, in which the Casa de la Justicia vein is found crossing the Barranco Piedras Berinejas. The outcrop follows the direction N. 36° W., with a dip of 45° to the S. W.

Mina Santa Eloisa, in the Valdeinfierno, with three distinct veins, of which the Cuevas Secretas is the most important. It has been worked from early times, and several comparatively recent tunnels are still open. The strike is N. 34° W., and the vein stands nearly vertical, with an average width of 1.2 m. (4 ft.). The following assays are given, representing samples from the various workings: Copper, 4.50%, 4.11%, 3.75%, 3.21%, 3.50%, 6.00%, 4.22%.

Mina Santa Filomene, at the intersection of the Valdeinverno and the Barranquillo de la Mata. The width is 0.9 m. (3 ft.), dip nearly vertical, and the lode-matter consists of siderite with disseminated chalcopyrite as usual. Three samples assayed: Copper, 3.78%, 13.85%, 5.05%.

Mina Duquesa, on which is the Veta Grande, crossing from the Valdeinfierno to the mountain mass of La Veleta at the head of the Arroyo de Guarnón. The outcrop lies mostly at an altitude of more than 10,000 ft. The strike is N. 10° W. and the dip is 30° to the southwest. The iron carbonate is well crystallized, and heavily impregnated with chalcopyrite, but no assays are given. The width of the vein is 5 m. (16.4 ft.).

Minas Angustias, Esperanza, and Triunfo, crossing the Arroyo de Guarnón on a course N. 28° W. The dip is S. 50° W. and the average width is 0.3 m. (1 ft.). Legrand notes that these three veins are exceptionally rich in copper, and there is also much stibnite. No assays are reported.

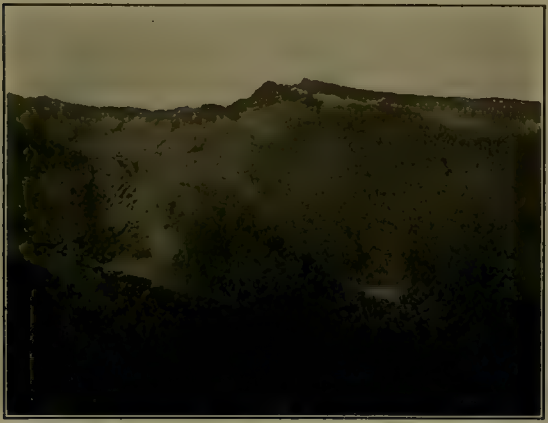
Mina Leon de Plata, outcropping on the right bank of the Guarnón, with a strike N. 38° W., and a vertical dip. Three galleries were accessible at the time of his visit. He notes the prominent gossan, and a width varying from 6 to 7 m. (19.68 to 22.96 ft.), and an unusual amount of chalcopyrite. From his description it would appear to be as important as the Rascal vein lower down in the same arroyo. It was plainly visible from the canyon, but I had no time to stop and examine it. With insufficient details Legrand mentions also the following properties: Eugenia Benéfica, Riqueza de mi Paco, Mi Manuel, La Lola, La Suiza, El Guante, Los Descuidados, and Caimán.

From the foregoing, and in the light of my own investigations, it would appear that the region is traversed by a large number of veins, most of which are small, but which could be worked on tribute if there were a local market for the ore; moreover, there exist three or four large veins that might prove, on development, to be of sufficient size to constitute a basis for a large mining enterprise. The Rascal is an exceedingly promising vein, and is at a relatively low altitude. The Veta Grande and León de Plata would appear to be important, and the Bacares vein is certainly of large size and is favorably situated for economic operation. This is set forth by the sketch on the previous page. I had no means of determining correctly the altitude of the outcrop above the bottom of the canyon, nor the horizontal distance between the outcrop and the stream. My judgment is that the altitude is 2000 feet and the horizontal distance about 3000 feet.

Preliminary exploration could be made by a shaft following the inclination of the vein to a depth of 500 ft. or more, to prove the character of the deposit, before the quantity of water to be handled would become prohibitive. It would then be necessary to continue development by means of an adit driven from a lower point in the canyon. As appears from the sketch, there are four smaller veins outcropping within a distance of 1000 ft. from the outcrop of the Bacares vein. Two of these are opened by shallow shafts, now collapsed, on the walls of which, near the surface, I could see the veins, which were from 12 to 18 in. wide and composed of solid mineral. The ore on the dump was siderite with chalcopyrite, similar to that found in all the veins of the district.

The climatic conditions are extremely favorable for out-door work from April to December. The winter is said to be severe and the snowfall is heavy. This would be indicated by the persistence of snow in sheltered spots above an elevation of 10,500 ft. throughout the year. As compared with Leadville and the San Juan region of Colorado, or the Wasatch range of Utah, however, the conditions met in the Sierra Nevada of southern Spain offer no obstacles of a serious nature. After a camp was established, work could continue with no interruption from the weather throughout the winter months. Excellent level sites for camps and shops exist, both on the heights near the outcrop of the Bacares vein and in the valley at the foot of this spur. Good roads, suitable for mule-back transportation, have been cut from the Barranco de San Juan to Valdeinfierno, 5½ miles, and there is a wagon-road, recently repaired, from Güejar to Barranco de San Juan, a distance of about 3 miles. The descent from Valdienfierno to Barranco de San Juan is about 4450 ft. A good impression of the character of the canyon is afforded by the views on page 291 showing the peaks of Mulhacén and Alcazaba from the trail up the Genil, which was taken about midway between the Barranco de San Juan and La Estrella. It is evident that the route is entirely practicable for a rope tramway, either from the heights at the Bacares outcrop, or from Fábrica Real at the mouth of the Valdeinfierno. A similar cable-way could deliver ore from the Veta Grande to Fábrica Real, a distance of perhaps two miles, or it could come down the Arroyo de Guarnón, to the Rascal mine at the mouth of that valley, which would be directly on the route from Fábrica Real to Barranca de San Juan. Such a branch cable-way, on either course, would pass the Leon de Plata.

From the Barranco de San Juan it is now possible to ship by a narrow-gauge railroad (0.60-m. gauge) to Granada. This road is the Tranvía de Granada á Sierra Nevada, with a nominal capital of 1,200,000 pesetas, controlled by the Duke of San Pedro, resident in Granada, who is also the owner of the elegant Alhambra Palace Hotel at that place. Primarily the project was intended to meet a growing demand from tourists and pleasure-seekers for recreation in the high Sierra. A lodge was established at the Barranco de San Juan for their accommodation, and excursion parties were escorted under the guidance of employees of the Alhambra Palace Hotel. It became apparent that a first-class tourist hotel in the Sierra, having rail communication with the Alhambra Palace in Granada, would enjoy a large patronage. It is the most perfect summer climate conceivable. The distances, according to the surveys made for this railroad, are the following:



THE VALDEINFIERNO, SEEN FROM THE BACARES MINE

	Km.	Miles
Granada to Pinos Genil	10.5	6.5
Pinos Genil to Güejar de la Sierra	5.0	3.1
Güejar to Charcón (Barranco de San Juan)	4.8	3.0
	20.3	12.6

The route lies through Cene de la Vega, Pinos Genil, and Güejar, and the location has maximum gradients of 2.5%. At present steam-power is employed, but the line will be electrified later. The estimated traffic available amounts to 40,000 tons per annum, in addition to which the company counts upon developing the marbles in the vicinity of Güejar and the serpentine in the Barranco de San Juan, and anticipates the exploitation of the lead, zinc, and wulfenite (molybdenum) mines in the limestone region roundabout the same town, in consequence of the stimulus of improved transportation facilities. A favorable contract could be expected for transporting the freight that would result from the operation of the Bacares group of copper mines. Concerning this railway enterprise, communications may be addressed to the Duque de San Pedro, Karmen de Benatua, Granada.

Mention has been made of the existence of abundant water in the Genil. This fact, in conjunction with the rapid fall in the canyon, will suggest the possibility of power. One hydro-electric plant belonging to Lebon et Cie., of Paris, who control the electric railways of Granada, is established about one mile above Pinos Genil, taking water at an altitude of about 400 ft. above the wheels between Canale and Güejar. This plant develops approximately 2500 hp., all of which is under contract. The water-power in the upper Genil valley is held under a concession by Huberto Meersmans (Finca los Mártires, Granada). Three separate plants would be required. The Genil project contemplates taking water from the junction of the Valdeinfierno with the Genil, adding to the ditch the waters from the Guarnón, and thence continuing to the Barranco de San Juan, which would add materially to the volume. The total power available at this point is 3000 hp. On the southern slope of the Sierra Nevada, Señor Meersmans holds another concession where it is estimated that 3500 hp. is available, and in the Capileira valley he owns a third concession, with an estimated 2000 hp. He has accordingly a grand total of 8500 hp. The project, according to the estimate of his engineers, would require an investment of about 8,000,000 pesetas (approximately $1,600,000).

OUTCROP OF THE BACARES VEIN

The scattered concessions covering the numerous copper veins in the upper valley of the Genil have been gathered together into a solid block under the ownership of Dr. José Jiménez Gómez, No. 60 Gran Via, Granada, and he has made a liberal offer through the Bureau of Foreign and Domestic Commerce to American capital for the development and purchase of the property. It is a promising group of deposits, an unusual and interesting type of ore, with indications of great persistence in depth. The ore is primary, with the exception of some superficial enrichment in chalcocite. Since the slates are nearly totally lime-free, the carbonate of iron is clearly not produced by substitution for lime-carbonate, a reaction that appears to be indicated in the case of some deposits of spathic ore elsewhere in Spain. Under these circumstances there is no reason to anticipate a change in the character of the Sierra Nevadan deposits with greater depth. The existence of veins such as the Rascal, maintaining the same character through a depth of nearly two thousand feet, as shown by erosion, is a further argument in favor of the possibilities of the persistence of the Bacares lode and the Veta Grande to depths that would make them highly important.

The reason these ores have not been utilized is that it has been impossible in the past to separate the chalcopyrite from the siderite gangue, because the specific gravity of siderite is from 3.8 to 3.9 and that of chalcopyrite is 4.1 to 4.3. The margin is insufficient. Neither was it possible to smelt an ore containing above 45% metallic iron and about 3% copper, and with expensive fuel. The existence of aggregations of chalcopyrite in masses of sufficient size to yield a relatively high-grade ore, and the discovery here and there of ore-shoots enriched by secondary copper sulphides, made possible desultory operations on a small scale in times past, aided by excessively cheap labor. The solution of the problem is to be sought in the separation of the chalcopyrite by flotation, and in the utilization of the iron-carbonate tailing as an iron ore.

As there would appear to be no waste material in the ore that would be shipped from the mine, it would seem that the ore might be delivered for treatment to a port like Seville, which would have the advantage of being a good distributing point for the finished product, and as the waters of the Guadalquivir are already loaded with silt, no complaint could arise from the further addition of small quantities of slime from settling devices, whereas the contamination of the crystalline waters of the Genil would produce a storm of protest from the truck-farmers who have turned the valley of that stream, from Granada to Pinos Genil, into one of the most luxuriant gardens in the world. Furthermore, at tide-water, fuel would be far cheaper than at Granada. The distance from Granada to Seville is only 121½ miles. This is an opportunity for the development of a copper mine that should attract the attention of American capitalists experienced in operations of this character.

During the War it became necessary to examine and estimate domestic ore-reserves with a view to supplying the increased demand for certain mineral products, among them sulphuric acid, which is made from pyrite, states a U. S. Geological Survey bulletin. One of the most promising developments in this connection is the conversion of the well-known Haile gold mine, near Kershaw, S. C., into a pyrite mine. This mine has been the largest single producer of gold in the Appalachian region. It was successfully worked from 1830 to 1908 and produced during that period $3,500,000 in gold. Much of this was mined from open-pits 200 ft. deep. The ore consists of pyrite abundantly diffused through a gangue of sericite and quartz. The pyrite is fine-grained and relatively pure. It increases in amount with depth and extends below the deepest workings, whose depth is 350 ft. In exploiting it, test drill-holes are sunk nearly to that depth. A large part of the deposits can be advantageously worked in open-pits with a steam-shovel. In concentrating the ore, jigs, settling-tanks, and Wilfley tables are used.

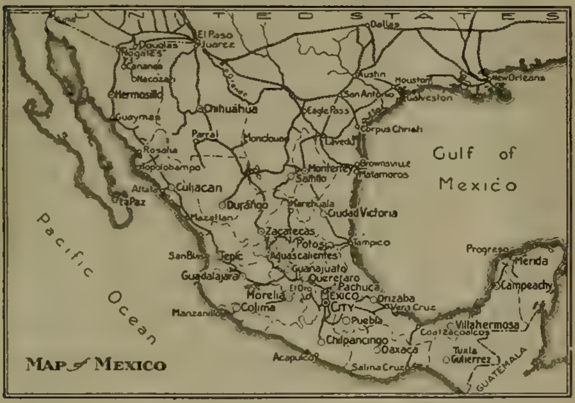
Although the rich iron-ore deposits at Kirunavaara, in the extreme north of Sweden, are calculated to contain 1,200,000,000 tons, of which rather more than 30,000,000 tons has been extracted, the Luossavaara mine was only taken in hand in the spring of 1921, states 'Engineering'. In 1907 the State secured the right of working the mine, but during 1918 an arrangement was made between the Swedish State and the Grängesberg-Oxelösund Trafik Aktiebolag, whereby the latter concern and the Norrbotten Ironworks Co. secured the exclusive right of exploiting these deposits from 1919 to 1930, subject to a payment to the State and certain regulations as to working, both as regards quantity of ore broken, the limit of quantity for export, and the quantity set aside for home consumption. The Luossavaara ore mountain is about 2½ miles from Kirunavaara, and the occurrence of iron ore was discovered at the same time (about 1736). The mountain rises to a height of 229 metres above the level of the neighboring lake of Luossajärvi, whose level again is 730 m. above sea-level. Geologically, Luossavaara is much like Kirunavaara, but the ore, on the whole, contains less phosphorus than that from the latter place. As the ore from the former locality has not been worked to any extent, its quality is only known from a large number of tests, which show an iron content of 65 to 70%, with phosphorus from 0.004 to 4.2%. The exposed portion of the deposits has an area of about 25,000 square metres, and the quantity of ore above the level of Lake Luossajärvi is calculated at 22,500,000 tons, besides what may be found in portions of the deposits which have been only partly investigated or not at all. Diamond-borings on the Kirunavaara side, close to Luossajärvi, have shown that there was still iron ore at a depth of 300 m. below sea-level; the borings did not get beyond the ore, and it is surmised that the extent of the ore increases with depth. The installations for working comprise a railway from Luossavaara to the Kirunavaara ore-railway station. A separate power-station has been erected, obtaining current from the Kirunavaara power-station, the current being transformed from alternating to continuous. There is an air-compressor for boring purposes. A goods and passenger line has been constructed to the top of the mountain, and a chute for lowering the ore to a four-chambered ore pocket, from where the ore passes straight to the State railway wagons.

Conditions in Mexico

By An Occasional Correspondent

Since my last letter was published in the 'Press' of April 9, 1921, things have been happening in Mexico as well as at Dublin and Washington. At that date silver was at its lowest price for five years, at 56 cents per ounce, and all domestic mines were running behind, but since its rise of 10 cents from this low point the mines that have the advantage of transportation and financial facilities can operate at a profit. However, these qualifications exclude numerous mines from activity, and one must first understand how the railways and banks got into their present distress before one can predict how they can get out of it.

Going back ten years, to the time of President Madero, we find that the bulk of the railroad operating officials, as well as the engineers and conductors, were Americans. During the last years of the Diaz régime, the Mexican government had acquired control of the directorate of the National Railway system, but most of the property was still held by foreigners through their ownership of the bonds. After the Madero revolution, the anti-foreign faction of the Mexican middle class emerged for the first time into the open, and has since had a powerful influence on the policy of the Government. One of the first important moves of this faction was to 'purify' the National Railway system of its foreign train-hands, by issuing an order requiring all official communications on the lines to be in Spanish. As most of the Americans were unable to write anything but English, they went on strike in protest and have never been taken back. In their places were placed the Mexican understudies of the American engineers and conductors, and they were given the same wages as their predecessors. This was the first step toward ruin, because the Mexicans lacked both the intelligence and the experience of the Americans, especially in the maintenance of locomotives, and therefore should have been paid lower wages, to balance the greater cost for repairs due to their incompetence.



However, as long as the American division-superintendents and master-mechanics were retained the trains were continued in regular operation; but this only lasted for two years, until the capture of Vera Cruz in April 1914 obliged all American officials to resign. A few months later, with the arrival of the triumphant revolutionists from the North, the railway service became disorganized. Large numbers of trained officials were replaced by novices, whose only qualification was a political one, and much of the rolling-stock was used for military purposes. The all-night train service was suspended between the summers of 1914 and 1920, and to date it has been partly resumed only on one or two main lines. The constant guerilla warfare, which ended with the fall of Carranza, accounted for the loss of hundreds of cars and locomotives, and the incompetence of the native engineers and repair-shops for as many more.

Although many of the early revolutionists, especially the Sonorans, were patriots fighting for principle, the rise to supreme leadership of Carranza, trained in the corrupt Diaz school of politics, brought into prominence a host of grafters who proved as greedy and destructive as a swarm of locusts, not only in the direct employ of the Government but in that of the National Railways. It soon became impossible to obtain cars for shipping ore or bullion without bribing a railway official or some military satrap controlling the division as one of his perquisites. In the last days of Carranza, affairs became so bad that Juanito Barragan, chief of staff and said to be the son of the President, auctioned the administration of the National Railways to the highest bidder—Colonel Fontes.

Meanwhile the railway labor-unions, advised by cunning leaders from abroad, had been gaining power steadily. All bond-coupons had suspended payment in 1913, so the operating revenue of the railways thenceforth had only to be divided between the politicians and the unions (outside of a minimum allowed for supplies). All new construction had ceased, and rolling-stock and stations that had been destroyed were not re-built. Having aided Obregon to overthrow Carranza, the railway unionists demanded their reward; and when their leaders met at Mexico City in a convention, in the autumn of 1920, they were all paid big salaries for several months; and they would still be in session had not the Government become disgusted and withdrew the subsidy after expending ₱156,000. In revenge for their severance from the public payroll, the union leaders called a strike for terms which they finally obtained, for the unionists all returned to work at greatly increased wages. But as the non-unionists who had been hired to operate trains during the strike were also retained, this greatly padded the payrolls and resulted in the crushing expense that has been bleeding the railways white during the past year. It seems incredible, but it is true, that locomotive engineers have been earning from ₱1000 to ₱1500 per month, and even common brakemen ₱300. Many of these are erstwhile peons who would have been glad to get ₱100 per month ten years ago.

At present writing, although the pacification of the country has prevented the further destruction of railway equipment, and the executive triumvirate, which has recently replaced Manager Perez in the administration of the National Railways, is said to be composed of honest men, the railway situation is bad. Little has been done to detect and weed out the host of minor officials who learned grafting under Carranza, and there is a sad deficiency in rolling-stock. About the only people who can be assured of regular freight service are the big operators, such as the American Smelting & Refining and the Real del Monte companies, who own their own cars and locomotives. Within the last year little has happened to improve the banking situation. The 24 State banks, with a few exceptions, are still paralyzed, and are likely to remain so until they are paid the ₱50,000,000 of which they were robbed by Huerta in 1914. While Congress continues to be dominated by cheap demagogues there is little probability of this being done; but until it happens the project of the Constitution of 1917 to establish a Unique Bank of Issue can never be realized. Meanwhile Mexico must continue to do business without bank-notes and with few banking facilities of other kinds.

Of late the National Agrarian Commission has been much in the public eye. Organized to carry out the agrarian projects of the last part of the famous Article 27 of the Constitution, it has done enough already to prove the injustice of the prescribed means of acquiring the land. The main idea is to restore to the thousands of Indian villages, scattered throughout the Republics, the *egidos* (reservations) that have been lost or reduced in size in various ways since the law of disamortization of the church estates was mistakenly applied to them by the Constitution of 1857. By the new Article 27, any village can recover its ancient *egido*, without payment from its present private owners, unless the latter can prove a clear title since 1857; and even owners with clear titles must accept payment for any of their land granted for *egidos* in State bonds at the fiscal price. As rural estates are usually much under-valued by the authorities and as the State bonds have no market value—in fact, have not even been printed as yet—this transfer of land for *egidos* has been a disaster for its former owners.

The Minister of *Fomento* (Promotion) General Villareal, who has directed the work of the National Agrarian Commission, may be classified as one of the originators of the Revolution. Associated with the notorious Magon brothers and other agitators of Los Angeles, in the last days of Diaz, he first became prominent in the revolt against Huerta. Less radical than the Magons, who were simon-pure communists, Villareal was a man of action rather than an intellectual, and not unskilled as a demagogue. As Minister of Fomento he did not scruple to send out agents who told the Indian villagers to take what they needed of the forests or stock of the neighboring estates, and it was this encouragement of anarchy, combined with using his office as a means to further his own presidential ambitions, that compelled Obregon to ask for his resignation in December 1921.

With the expectation of taking the vacant ministry of Fomento, General Enrique Estrada resigned as the Secretary of War in December; but when he outlined his proposed policy it proved so discordant on the agrarian question with that of the President that he was finally refused the appointment. Thus, both the departments of Fomento and War are now lacking a minister. The third vacancy in the Cabinet happened on January 1 by the resignation, by request, of Liceniado Zubaran-Campany, the head of the Department of Industry, Commerce, and Labor, one of whose bureaus is that of Mines and another of Petroleum. The recent history of this ministry has been scandalous. The last incumbent, General Trevino, was not asked to continue in his post when Obregon took over the presidency, as he had been engaged in granting illegal monopolies for the exploration of whole States for petroleum. Shortly after his retirement from the Cabinet, he was put in jail for the murder of General Alessio Roblez and has been there ever since. Everyone was surprised when Zubaran-Campany was appointed as the successor of General Trevino, for he had been formerly the law-partner of Luis Cabrera, the evil genius of the Carranza régime. But the explanation was a personal liking of the President for him, acquired during a journey together in Tabasco some years ago. The friendship has proved, this year, to have been sadly misplaced, because the case of bribe-taking for which Zubaran-Campany was dismissed was only one of dozens of which he had been guilty as Minister.

One of the so-called reforms incorporated into the Constitution of 1917 is the "free municipality". This scheme abolished the Latin organization of prefectures into which each State was formerly divided for policy purposes, and partitioned a State into municipalities equivalent to American counties—each of which was governed by a municipal council elected by universal male suffrage. In the rural districts, where Indians and mestizos dominate, this change has meant a reversion to barbarism. Civilized enforcement of law has practically ceased. First, because the local officials are ignorant of their duties and disinclined to punish their neighbors for crime; and second, because they have no mounted police to arrest offenders, as the State *rurales* (rural police) of the Diaz régime have also been 'reformed' out of existence. A mining company therefore must operate a mine in the outlying districts at its own risk, and be prepared to maintain its own police force for self-protection. Thus while the whole country may now be said to be 'pacified', as regards armed bands of rebels, individual criminals and sporadic groups of brigands are still numerous, and will continue to be so until some horse-sense replaces a large part of the doctrinaire democracy of the new Constitution.

Hydro-Metallurgy of Low-Grade Zinc Ores

By Motohiro Namba

*The amount of zinc ore mined annually in Japan is between 35,000 and 40,000 tons; there is in addition a considerable quantity of low-grade ore containing 20 to 30% zinc, which it has not up to the present time been considered possible to concentrate economically, either because the quantity in any particular instance is too small, or because the condition is unsuitable. Low-grade ores of this kind, and more especially those containing notable quantities of precious metals, may be treated most economically by a wet process of extraction.

One of the principal factors regarding the usual zinc-smelting operation is the preparation of retorts suitable for distillation. To obtain these at a reasonable cost compared with the market value of the metal, it would seem necessary to have an establishment with a productive capacity of about 20,000 tons of zinc per year.

In the case of Japan, where the annual demand for zinc is only 10,000 to 15,000 tons, it would thus seem most desirable to concentrate the smelting of zinc in one district. Against this, however, it must be remembered that although the total output of zinc ores in Japan is sufficient to meet this, they are obtained from many localities separated by considerable distances, and it would be costly to transport them to one place. On this basis it would, therefore, seem that Japan is not in a favorable position for zinc smelting on a large scale.

With the object of solving the problem of extracting the zinc from the ores mined in Japan, an investigation on the hydro-metallurgy of zinc was undertaken by me at Sakai, near Osaka, in 1910.

After many trials of wet and dry processes, the wet process to be described in the present paper was finally adopted by the Takachiho-Seirensho, in Yamaguchiken.

The ore used in the experiments was that from Wanibuchi, and had the following composition: zinc, 32 to 35%; copper, 1.5 to 2.5%; lead, 7%; sulphur, 22 to 25%; barium, 3%; silver, 0.0323%.

The object was to extract the maximum possible quantity of zinc, and leave a residue in a convenient form for the recovery of the copper, lead, and silver.

The more important preliminary factors relating to the hydro-metallurgy of zinc are: (1) A high lixiviation yield of zinc from the ore; and (2) the almost complete purification of the liquor thus obtained by the removal of such impurities as lead, copper, iron, manganese, or silica. The success of the former operation depends to a large extent upon the degree to which the zinc sulphide is converted into the oxide during the roasting process; but as this is equally important for the recovery of metal by dry distillation methods, it calls for no special comment in the present instance. It is, however, necessary to deal in some detail with the latter operation, because it is peculiar to the wet-extraction process, and has a considerable influence upon its success.

Höpfner Process

In the Höpfner process for the wet extraction of zinc from its ores, hydrochloric acid is used as the solvent; but unless there are special reasons for using this reagent, it is generally considered that treatment with dilute sulphuric acid is more economical.

Purification of Mother Liquor. The impurities contained in the crude liquor after treating the roasted ore, when sulphuric acid is used as the solvent, are silica and the metals of the second and third groups. The metals belonging to the second group can be removed readily from solution by the addition of zinc dust. Cadmium, however, is so closely allied to zinc as to render the removal of the last trace difficult. Nevertheless, it has been found that the small amount of cadmium that escapes precipitation by zinc dust does not materially influence the subsequent treatment of the solution.

The usual method for removing metals of the third group is by adding small quantities of bleaching-powder and milk-of-lime, or precipitated calcium carbonate. In this connection, however, I have observed that with some solutions it is not possible to effect a complete removal of iron and manganese with the above reagents without the precipitation of a substantial quantity of zinc. In the case of such solutions, it is necessary to add a considerable quantity of milk-of-lime in excess of that which would normally be required for the removal of iron and manganese, and this, of course, causes the precipitation of notable quantities of zinc, which cannot afterward be conveniently recovered. There are, therefore, two kinds of solutions, namely, those from which the iron and manganese can be readily removed by the necessary amount of bleaching-powder and milk-of-lime, and those from which this separation is incomplete without loss of zinc. As a result of many experiments, I have found that there is a difference between those solutions that can be purified easily from iron and manganese and those that cannot. This difference is traceable to the character of the zinc ores themselves.

Action of Dissolved Silica. Broadly speaking, zinc ores may be divided into two groups, one of which gives considerable quantities of dissolved silica on being treated with sulphuric acid, and the other giving only small amounts of silica in solution. I have found that solutions containing much dissolved silica can be purified easily from iron and manganese by adding the necessary quantity of bleaching-powder and milk-of-lime; but with those

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containing little silica the iron and manganese can be removed only by using considerable excess of alkali. In the acid solutions after treating the zinc ores, the iron, manganese, and silica exist in the colloidal state, and the milk-of-lime or calcium carbonate first acts upon the colloidal sol of silica and converts it into colloidal gel, thus facilitating the separation of iron and manganese as a colloidal precipitate. This colloidal precipitate can be filtered easily; after its removal the solution is clear and free from iron and manganese. This solution can then be used for the production of high-grade zinc-white by precipitation of zinc hydroxide and subsequent conversion into the oxide, or for the preparation of pure zinc by electrolytic deposition.

SODIUM BISULPHATE AS SOLVENT. As sodium sulphate is one of the best catalysts for the coagulation of the colloidal solutions of iron and manganese, I prefer to use sodium bisulphate in place of sulphuric acid as the solvent for roasted zinc ores. Sodium sulphate not only assists in the removal of iron and manganese, but it also gives a more satisfactory solution for electrolytic purposes. The details of the operation are as follows:

The pulverized roasted ore is mixed with a 20% solution of sodium bisulphate, sufficient to dissolve the copper and zinc compounds, and the mixture is heated to 100°C. for about 30 min., diluted with warm water, and filtered. The solution containing metals such as copper and zinc is then freed from the heavy metals by means of zinc sheets or zinc dust and subsequent filtration. The filtrate is neutralized by adding alkali, and a suitable oxidizing agent is introduced; nearly all the iron and manganese is thus precipitated. To remove the remaining iron and manganese, the solution is boiled with a solution of sodium silicate rendered neutral to litmus by adding an acid; the strength of the sodium silicate solution and the quantity added are not of vital importance provided there is a distinct precipitate of gelatinous silica in the boiling liquid.

If the solution is to be used for the electrolytic deposition of zinc, traces of copper and cadmium that are only sufficient to give a slight yellowish or brown coloration with hydrogen sulphide do not materially influence the compactness of the deposited zinc. Iron, on the other hand, has the serious effect of giving a spongy deposit of zinc; this is manifest even when the solution shows only a slight red tint on testing with potassium thiocyanate.

The effect of manganese on the character of the deposited zinc is not so pronounced as that of iron—in fact it tends to neutralize the action of iron in producing a spongy deposit. The presence of manganese in the ore during the roasting process facilitates the oxidation of ferrous iron to ferric, and thus gives a solution that is more easily purified.

PREPARATION OF ZINC WHITE

Caustic soda would be too costly for use in precipitating zinc from the purified solutions. The cheapest precipitant for the separation of zinc from zinc sulphate solutions is milk-of-lime; but in this case the precipitate obtained is a mixture of zinc hydroxide and calcium sulphate, in which the maximum percentage of zinc oxide is 50, even when an allowance is made for the fact that calcium sulphate is slightly soluble in water; the solubility may be taken as about 0.2%. The following figures are given in Seidell's table:

Solubility of Calcium Sulphate in Water

Percentage in solution	Temperature, °C.
0.1759	0
0.1928	10
0.2016	18
0.2080	25
0.2090	30
0.2096	35
0.2097	40
0.2009	55
0.1932	65.3
0.1847	75
0.1619	100

The subjoined table gives the theoretical percentages of zinc oxide present in the mixed precipitates of zinc hydroxide and calcium sulphate, prepared by precipitating all the zinc from sulphate solutions by adding the chemically equivalent amount of milk-of-lime.

Amount of zinc in mixed solutions, %	Highest possible amount of ZNO in the mixed precipitate, %
10.0	37.59
8.0	37.68
6.0	37.80
4.0	38.02
2.0	38.76
1.0	40.18
0.8	41.17
0.7	41.80
0.6	42.80
0.5	43.90
0.4	45.88
0.3	49.66

Although calcium sulphate is slightly soluble in water after it has been precipitated from zinc sulphate solutions by means of lime, it is impossible to separate it from the zinc hydroxide by washing with water, as is proved by the following experiment:

A portion of the purified zinc sulphate solution was diluted with water so as to contain 0.7% of zinc and then decomposed by milk-of-lime at the room temperature (10°C.), using phenolphthalein as indicator; separate portions of the mixed solutions were allowed to stand for 30 min., 2 hr., and 24 hr., and then filtered and lightly washed with water. The precipitates were found to contain: after 30 min., 74.4% ZnO; 2 hr., 46.6%; 24 hr., 39.4%.

To test whether the calcium sulphate could be extracted by washing with water, portions of the precipitates, after standing for 2 hr. and 24 hr., were washed with distilled water until the washings gave no turbidity on testing with barium chloride. The precipitates were found to contain 55.0 and 51.5% zinc oxide, respectively. Although this experiment indicates that the amount of calcium sulphate contained in the precipitate can be reduced, it shows the impracticability of using such a method for eliminating the greater portion of it.

On comparing the results obtained after allowing the precipitate to stand in the mother liquor for different times, it is evident that immediately after the decomposition of the zinc sulphate solution the calcium sulphate exists in the mother-liquor as a supersaturated solution and that it gradually separates on standing.

In view of the foregoing considerations it was at first thought impossible to develop a process for the manufacture of zinc oxide from purified zinc sulphate solutions, prepared from roasted zinc ores, by direct precipitation with milk-of-lime. Further, all attempts to obtain zinc from the mixed precipitate consisting of zinc oxide and calcium sulphate by distillation with carbon were unsuccessful. Possibly this failure was due (1) to the relatively low zinc content of the double precipitate, and (2) to the possible formation of zinc sulphide in the presence of such large quantities of calcium sulphate.

Taquet proposes to convert the greater part of the sulphate into chloride by adding alkaline-earth chloride and then to precipitate the zinc as oxide by means of lime, but in this case also the oxide is contaminated with much calcium sulphate, although it could be used for making lithopone zinc sulphide. After numerous experiments I found that Taquet's process was impracticable, because the reaction between zinc sulphate and chloride is not complete, and it is exceedingly difficult to determine when the end point of the reaction has been reached. Further, as the precipitate of calcium sulphate is voluminous, it is impossible to recover the zinc chloride. This causes a substantial loss of zinc.

Lance has proposed to separate zinc oxide from zinc sulphate solution by bringing calcium bisulphite, produced separately or in the solution itself, into reaction with the zinc sulphate in presence of an excess of sulphurous acid. After filtering the calcium sulphate, the zinc sulphite is precipitated by neutralizing the acid solution with zinc oxide. The zinc sulphite thus obtained is then converted into the oxide by calcination.

Later Lance improved this process by using barium oxide of lime. The following is a brief outline of the modified process: Sulphur dioxide is passed through the zinc sulphate solution under pressure, and, at the same time, barium oxide is added. The amount of barium oxide used should be less than half that required to combine with the sulphurous acid in the solution as barium sulphite. In this way barium sulphate is precipitated, and an acid solution of zinc sulphite obtained. On removing the excess of sulphurous acid in the solution, zinc sulphite is precipitated, and can be converted into the oxide by calcination, with the regeneration of sulphurous acid. Barium oxide is regenerated in the usual manner, and thus a working cycle is obtained. Lance's process is complicated, and requires skillful devices and trained labor to carry it out on a manufacturing scale.

However, as will be seen later, it was found possible to prepare zinc hydroxide in a comparatively high state of purity by precipitating the zinc directly by lime. This became possible by utilizing the marked tendency that calcium sulphate possesses to form relatively stable supersaturated solutions.

Before proceeding to describe by process, it will be useful at this stage to refer to and discuss the literature bearing on the subject of supersaturated solutions of calcium sulphate.

As the action between water and calcium sulphate is extremely slow, the solubility of this salt has formed the subject of investigation by numerous workers. Cameron[1] examines the results of previous workers and suggests that the discrepancies were due to the exceptionally slow rate at which calcium sulphate is dissolved by water, or, in other words, the long time it requires to reach a normal state of equilibrium.

Marignac[2] explains the discordant data on the basis that calcium sulphate forms supersaturated solutions; this has a considerable influence upon the apparent solubility of the salt. He also points out that much time is required before normal equilibrium is reached, even when particles of the solid salt are in contact with the solution.

Hulett[3] noticed that the solubility of gypsum in water increased with degree of fineness. This was attributed to the increase of the surface of contact between the solid and liquid.

Hulett and Allen[4] made a careful study of the solubility of calcium sulphate in water, and as their results are considered to be the most reliable they are given in Seidell's solubility tables.

Cavazzi[5] obtained a supersaturated solution of calcium sulphate containing 9.49 gm. of calcium sulphate per litre by shaking gypsum with water for five minutes at the ordinary temperature. Cavazzi[6] also proved the existence of gelatinous calcium sulphate and showed that the formation of transparent particles when calcined gypsum and water are brought into contact is due to the production of a supersaturated solution of this gelatinous calcium sulphate, which is converted into stable calcium sulphate and crystallizes out after allowing to stand for a short time.

Cavazzi states that he obtained gelatinous calcium sulphate by mixing 0.5 gm. of plaster of paris with 25 cc. of cold water, filtering, and adding to the filtrate an equal volume of alcohol. Gelatinous calcium sulphate contains more water than gypsum and is more soluble in water than calcium sulphate ($CaSO_4,2H_2O$). In this way he explained the strongly supersaturated solutions of calcium sulphate, which had previously been observed by Marignac, and in his own previous investigations.

In my experiment, the precipitate of calcium sulphate obtained by adding alcohol to the solution was no doubt of the same nature as Cavazzi's gelatinous calcium sulphate. In that experiment the precipitate formed after either boiling the solution or allowing it to stand was in an extremely fine crystalline form; but that produced when alcohol was used possessed a distinctly gelatinous character, and it is for this reason that it is described as a voluminous precipitate.

Jones and Partington[7] have put forward a theory of supersaturation, according to which the solubility of a substance depends on the radius of the solid particles as well as on the temperature and pressure. They describe the radius of a particle which is in equilibrium with a supersaturated solution of a given concentration and at a given temperature and pressure, as the equilibrium size. The introduction into the solution of particles having a greater radius than the equilibrium size will produce crystallization, but if smaller particles are added they will dissolve.

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[1] 'Jour. Phys. Chem.', 1901, 5, 556.
[2] 'Ann. Chim. Phys.', 5e ser., 1, 274.
[3] 'Chem. Centr.', 1901, II, 161.
[4] 'Jour. Amer. Chem. Soc.', 1902, 667.
[5] 'Chem. Centr.', 1905, I, 1693.
[6] 'Zeit. Chem. Ind. Kolloide', 1913, 12, 196.
[7] 'Phil. Mag.', 1915, 29, 35.

When heat is absorbed on dissolving a solid in a nearly saturated solution, the temperature value corresponding with the equilibrium size will decrease if the radius of the solid particles is reduced. On the contrary, if heat is evolved, the corresponding temperature increases when the radius of the particles is diminished.

In ordinary supersaturated solutions belonging to the first type spontaneous crystallization would occur on introducing small particles when cooled below a certain temperature; the size of particle required to induce crystallization is smaller the lower the temperature. With solutions of the second class spontaneous crystallization would be brought about by heating above a certain temperature. An ordinary saturated solution of gypsum is an example of the second group.

The above theory is in complete agreement with the experimental data obtained by me in connection with the decomposition of zinc sulphate by milk-of-lime. Although the mother-liquor is highly supersaturated with calcium sulphate it is relatively stable in the cold, but spontaneous crystallization occurs on boiling.

Jones and Partington[8] have further proved the existence of supersaturated solutions of the second type, directly in the case of calcium butyrate and calcium acetate, and indirectly in the case of calcium sulphate (gypsum).

On calculating the degree of supersaturation into terms of percentage from Marignac's figures given above, the following results are obtained: Marignac: 0.877 immediately after decomposition; 0.319 after standing 24 hours; 0.320 after one month; 0.242 after two months; 0.224 after three months. Cavazzi, 0.949.

Although working with a different object in view, namely, for the recovery of zinc from zinc-sulphate solutions by means of milk-of-lime, I have obtained results similar to those referred to above, and found that the supersaturated solutions of calcium sulphate are sufficiently stable to permit complete filtration of the precipitated zinc hydroxide without appreciable crystallization of calcium sulphate.

The fact that these calcium-sulphate solutions are comparatively stable, even when they are in contact with solid particles of the salt, puts them in a class apart from the majority of supersaturated solutions. Further, just as the solubilities of the so-called practically insoluble substances vary within considerable limits, so the velocities at which they are precipitated also vary, although in many instances the actual rates cannot be measured.

With the solutions under consideration the calcium sulphate present in excess of the normal saturation possibly exists as a suspensoid, and the influence of the colloidal precipitate in the direction of destroying the supersaturated condition is feeble, even though it may slowly act as a nucleus of crystallization.

Influence of Other Salts. The solubility of calcium sulphate in water is affected by the presence of other salts. The salts usually found in industrial water are the chlorides and sulphates of sodium, calcium, and magnesium.

From the present point of view the chief conclusions to be drawn from the results of investigations are that the solubility of calcium sulphate is increased by the presence of sodium chloride and sulphate, and decreased by the chlorides of calcium and magnesium.

I found that the mother-liquor obtained on filtering the zinc hydroxide precipitated by means of lime from purified solutions of zinc sulphate, prepared by lixiviating roasted zinc ore with aqueous solutions of sodium bisulphate (nitre cake), contained higher percentages of calcium sulphate than could be accounted for by the normal increase in the solubility due to the presence of sodium sulphate. From this it must be concluded that sodium sulphate not only increases the normal solubility of calcium sulphate in water, but also increases the degree of supersaturation of solutions prepared in the above manner.

My French patent (No. 479,614) for the manufacture of zinc-white relates to a process for the preparation of zinc oxide by utilizing the supersaturation of calcium sulphate in the presence of sodium chloride and sodium sulphate.

EXPERIMENTAL

Many experiments were conducted with a view to determining differences in the physical behavior of zinc hydroxide and calcium sulphate during or after their precipitation, which might render it possible to effect a satisfactory separation of the two.

Perhaps the more important features in this connection are that the precipitate of zinc hydroxide from cold dilute solutions is light, voluminous, and flocculent, whereas that of calcium sulphate when precipitated under similar conditions is decidedly heavier, it being compact and crystalline. Hence it would seem that the former should settle out much more slowly than the latter when formed in the same mother-liquor. To test this I endeavored to separate the two compounds by utilizing the differences in the rates at which they settle in the liquid. The solution used was dilute, and it was observed that the upper portion of the mixed precipitate contained a considerably higher percentage of zinc than did the lower. Another significant fact noticed was that, when the mother-liquor was filtered, immediately after the addition of the milk-of-lime, a considerable amount of crystalline calcium sulphate separated from what was at first a clear filtrate; this must have been held in solution, in a supersaturated form, owing to the extremely slow rate at which it crystallizes from the mother-liquor. To obtain additional confirmation that calcium sulphate can exist in this form after the precipitation of zinc hydroxide from the sulphate solution by means of lime, the amount of sulphur trioxide was determined in the mother solution after immediate filtration following the decomposition of zinc sulphate by milk-of-lime both in cold and in boiling solutions. The original mixed solutions for this purpose contained 1.0, 0.8, 0.6, 0.4, and 0.2% zinc. Solutions containing more than 1.0% zinc proved unsatisfactory, owing to the extremely voluminous precipitate of zinc hydroxide preventing its ready settlement. The results obtained are given in terms of sulphur trioxide and calcium sulphate in the following table:

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[8] 'Jour. Chem. Soc.', 1915, 107, 1019.

Zinc in the mixed solutions	A		B	
	Cold solutions		Boiling solutions	
	SO_3	$CaSO_4$	SO_3	$CaSO_4$
%	%	%	%	%
1.0	0.475	0.808	0.109	0.186
0.8	0.491	0.835	0.111	0.189
0.6	0.518	0.881	0.107	0.184
0.4	0.309	0.526	0.107	0.181
0.2	0.229	0.389	0.116	0.197

It appeared desirable to determine whether the whole of the zinc contained in dilute solutions could be completely precipitated by lime, and none escape in the filtrate in the same way as did calcium sulphate. The zinc solution used for this purpose was the ordinary sulphate purified in the manner already described. This solution contained 5.8% zinc, but to make the conditions drastic, 81.9 cc. was diluted with water to 1900 cc., thus making a solution containing 0.25% zinc. The whole of this dilute solution was treated in the cold, with freshly prepared milk-of-lime, using phenolphthalein as indicator. The solution was filtered through filter-paper, and the precipitate washed five times with water by decantation. The precipitated zinc hydroxide was re-dissolved in dilute hydrochloric acid and the zinc determined with the following result: zinc in original solution, 4.750 gm.; zinc in precipitate, 4.756 gm. The 0.006 gm. in excess of that known to be present is well within the range of experimental error. The result is sufficient to demonstrate that the zinc is, for all practical purposes, completely precipitated even when present in such extremely dilute solutions.

By means of the electrical conductivity method, Dupré and Bialas[9] have shown that one litre of water dissolves 0.0042 gm. of zinc oxide at 18°C.

From the figures given in the above table, it will be seen that the percentage of calcium sulphate in the mother-liquor after boiling is almost constant, as would be expected, and corresponds to the figure for the maximum solubility of the salt in water.

On comparing the results tabulated in Column A with those in Column B, it will be noted that after cold precipitation and filtration, the filtrate contains considerably greater quantities of calcium sulphate. The extra calcium sulphate retained in the filtrate under these conditions can only be present because the solution is supersaturated, or because the salt is in such an exceedingly fine state of dispersion as to correspond with a suspension colloid, which enables it to pass through the filter in the same manner as if it were truly in solution. It is, however, a matter of no great importance which of these views is correct, the essential feature being that the sulphate is carried through with the filtrate.

On allowing these filtered supersaturated solutions to stand for a few hours, the excess of calcium sulphate gradually separates in the form of minute crystals; or by adding a little ethyl alcohol, a voluminous precipitate of calcium sulphate separates instantly from the solution. As is well known, the separation of a crystalline precipitate of this kind from its solution is accelerated by the addition of solid particles, which act as nuclei upon which crystallization can occur more readily, or by continuously agitating the solution. In the present instance it was found that the separation of calcium sulphate occurred more slowly when large decomposing-vats were used than in smaller vats. In consequence the percentage of zinc oxide in the precipitate was much higher from the former than from the latter. In the small-scale commercial plant the decomposing-vats were elliptical in shape, 8 ft. wide, 17 ft. long, and 7 ft. deep; they were made of reinforced concrete and had two agitators. The amount of zinc oxide in the dried precipitate was never below 85% and was almost invariably above 90%; the amount of calcium sulphate present was 10 to 15%.

SEPARATION OF WATER FROM ZINC HYDROXIDE

The freshly precipitated zinc hydroxide produced in the above manner being of a colloidal character and extremely voluminous, it is difficult to get a filter-cake containing less than about 90% water by means of the ordinary filter-press. In order to eliminate the greater part of this water, the cake from the filter-press was heated by means of steam. At temperatures above 80°C. zinc hydroxide decomposes into zinc oxide and water, and therefore by once more filtering the steam-heated filter-cake the water-content was reduced to 20%. This last portion of water was removed at a comparatively low temperature by heating in a direct gas-fired drying-furnace.

The zinc oxide produced in this way may be used as a white pigment in the same way as the zinc-white made by the usual process of burning metallic zinc. In some cases, however, it may be more profitable to use this oxide for making pure zinc by distillation with carbon, or it may be used for making exceptionally pure zinc oxide or zinc dust free from heavy metals. Pure zinc of this kind is difficult to make by the direct distillation of ordinary ores.

Zinc oxide for good-quality rubber and zinc dust for the dyeing industry should be free from heavy metals. The composition of the distilled zinc oxide produced in the present work was: ZnO, 99.0 to 99.5%; impurities, 0.5 to 0.7%; moisture, 0.15 to 0.3%; and the composition of the zinc dust, Zn 90%, ZnO 10%.

When pure metallic zinc is required the author prefers to use the purified zinc sulphate solution already referred to, for the direct electrolytic deposition of the metal. The most objectionable impurity is iron, and in order to obtain satisfactory results it must be removed completely. As previously indicated, this can be accomplished if the mother-liquor contains sufficient colloidal silicic acid, which may come from the original roasted ore, or may be added later. It was stated that it is difficult to remove the last traces of copper and cadmium from the sulphate solution by means of zinc sheets or dust. Although they do not prevent the formation of a compact deposit of cathode zinc, it has been found that almost the whole of these impurities are deposited with the cathode-zinc formed in the first vats that the fresh electrolyte enters. The difference between the copper and cadmium contents of the cathodes from the first and last vats will be seen from the following figures:

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[9] 'Zeit. anorg. Chem.', 1903, 55.

	Pb %	Cu %	Cd %	Zn by diff. %
Cathodes from first vats...	0.022	0.04	0.024	99.914
Cathodes from last vats...	0.035	0.01	0.000	99.955

The electrolytic baths, which were 2.5 ft. wide, 6 ft. long, and 2.5 ft. deep, were wooden vats 1 in. thick, lined with best-quality asphalt; 32 of these were arranged in four rows, with eight in each row, and all the baths were connected in series. Fresh electrolyte was run into each of the first four baths of each series, and then from these to the next in the respective series, and so on, flowing out at the eighth. Seven cathodes and eight anodes were used in each bath. The number of electrodes varied with the current used, but the current-density was always between 10 and 11 amperes. The cathodes were double sheets of electrolytic zinc, 8 in. by 12 ft. The cathodes from the eight baths in each row were taken out when they became sufficiently heavy, every four days, and replaced by new ones. The new cathodes were prepared by depositing thin layers of zinc on the surface of rolled zinc or aluminum and then stripping the deposit from the original sheet.

The electrolyte flowing from the last baths in each series contains about one-third of the zinc content of the original electrolyte, and a corresponding increase in the sulphuric acid acidity occurs. This solution is used over and over again as a solvent for roasted zinc ores, either as it is, or with the addition of a little fresh acid.

	1st day	2nd day	3rd day	4th day
Average current density for each row, amperes per square foot...........	10.80	10.70	10.67	10.66
Terminal voltage, average per bath.....	3.41	3.34	3.38	3.38
Total current, amperes, average for 24 hr.	450	448	447	450
Average % Zn flowing into first bath....	5.7	6.0	6.2	6.2
Average % Zn flowing into last bath....	2.5	2.45	2.6	2.5
Average temperature of electrolyte, C...	35°	35°	35°	35°
Total increase in weight of cathodes from each row, pounds	177.3	172.7	182.0	173.3
Average current efficiency.............	76.6	74.7	78.6	74.6
Kilowatt-hours required per ton of zinc..	3550	3720	3550	3830

The above is a general description of my process, which may be subdivided under three heads according to the product desired: (1) electrolytic process; (2) production of zinc oxide suitable for white pigments; (3) production of specially pure zinc oxide by re-distillation.

With regard to No. 1, which is the customary method of extracting metallic zinc by the wet process, the solution for electrolysis should contain between 7 and 10% zinc if economical results are to be obtained. With No. 2 and 3 there is no restriction on the concentration of the solution. With process No. 2, however, pure lime is required, because any impurity reduces the quality of the zinc oxide produced; this does not apply to the third process.

Other things being equal, the higher the lixiviation yield of zinc the greater is the volume of the liquor. Hence, as the value of the zinc in solution decreases, for electrolytic extraction, with an increase in the degree of dilution, there must be a certain economic limit in this respect; as, however, there are virtually no limits of dilution for the successful working of processes No. 2 and 3, I am of the opinion that it is most economical to use these processes in combination with each other when dealing with low-grade zinc ores or zinc ashes.

From data of materials used and produced monthly the following ratios have been calculated; they may be regarded as a summary of the results obtained:

Date	I Ore lixiviated : ore roasted	II Coal : ore roasted	III Sulphuric acid : ZnO in products	IV Lime : ZnO in products	V Kw-hr. required per ton of zinc
September 1914	0.73	2.87	2.40	0.88	....
October "	1.03	3.26	2.90	0.81	....
November "	0.82	2.35	1.92	0.54	....
December "	0.87	2.85	1.88	0.67	....
January 1915	0.94	2.55	2.30	0.75	....
February "	0.82	2.41	2.80	0.91	....
March "	0.81	2.83	1.68	0.74	....
April "	0.79	2.65	2.10	0.88	4467
May "	1.08	2.90	3.15	1.10	4833
June "	1.24	3.30	2.80	0.78	4323
July "	0.88	2.43	2.48	0.80	5145
August "	0.85	2.30	2.30	0.76	4226
September "	0.77	2.45	2.20	0.85	4418
October "	0.76	3.47	1.38	0.47	4138
November "	0.87	2.82	2.55	0.82	3683
December "	0.85	2.55	2.40	1.20	4109
January 1916	1.00	2.50	2.50	1.00	4060
February "	0.97	2.25	3.10	1.15	4412
March "	0.95	2.30	2.49	1.00	4524
Average mean	0.90	2.70	2.38	0.85	4361

Ratio I expresses the loss in weight of ore during roasting, which, on the average, was 10% of the raw ore.

Ratio II gives the coal consumption for roasting, distilling, drying, steam-raising, etc.; the average is 2.7 times the raw ore.

Ratio III. Theoretically 81 parts of zinc oxide corresponds to 98 parts of pure acid; taking the composition of 50°B. sulphuric acid as 62% H_2SO_4, 98 parts of H_2SO_4 is equal to 158 parts of 50°B. sulphuric acid. Therefore, the theoretical ratio of 50°B. sulphuric acid and zinc oxide is approximately 2.0. In my work the average ratio was 2.38, and the difference of 19% is due to the fact that iron, manganese, copper, and cadmium were dissolved and also because the final liquor contained free acid.

Ratio IV. Theoretically the ratio of zinc oxide to lime is 81 to 56, or 1:0.7. The difference between 0.85 and 0.7 (0.15, or 21% of lime in excess) may be regarded as due partly to the lime necessary to neutralize the excess of acid contained in the sulphate solution, and partly to the presence of unburnt lime in the quicklime.

Ratio V. The average current required to deposit one ton of zinc was 4361 kw-hr., which is higher than the figure given in the previous table. In the monthly accounts, however, the current used was recorded before passing to the transformers, and if the efficiency of the transformer and motor-generators be taken at 80%, the results are in good agreement.

Book Reviews

Julian & Smart's Cyaniding Gold and Silver Ores. Third edition, revised and re-written by A. W. Allen. Chas. Griffin & Co., London. xxiv + 417 pp., ill. Price, 36s., net.

This treatise, which has been accepted as the standard text-book on cyanidation, was written in the first place largely from the South African viewpoint. The new edition shows that much of the matter has been rearranged in conformity with current practice, but no attempt has been made to minimize the primary importance of leaching in the beneficiation of gold ores, as exemplified by the preponderating amount of the precious metal that is obtained by this application of the cyanide process, and by the maintenance of output and the attainment of a high standard of technical result under adverse economic conditions on the Rand, at the Homestake, and elsewhere. In the preface the reviser pays a well-merited tribute to both Julian and Smart, drawing attention to the fact that the original treatise is a monument to successful scientific endeavor. Both authors made it their duty to present facts, without bias or prejudice, disregarding popular theories that were advanced without logical foundation, and taking infinite pains to reach a sound conclusion, even to the extent of carrying out extensive experimental work. The frequent reference to "Julian & Smart" as authorities, both in periodic technical literature and in text-books on the subject, offers sufficient evidence as to the worth of the original treatise. It is a matter for regret that Julian and Smart were not spared to carry out the revision, but Julian went down on the ill-fated 'Titanic' in 1912, and Smart was murdered by natives in South Africa in 1916.

The third edition will be found to contain much new material dealing with recent modifications in the theory and operation of the process. As previously mentioned, it was found advisable to rearrange the chapters; and the matter, as now presented, is classified roughly into (1) History, Preliminary Investigations and Theory—Chap. I to XX; (2) Practice—Chap. XX to XXXIII; (3) Equipment—Chap. XXXIV to XLIV. A large amount of material had been collected dealing with costs of equipment and operation, but this was discarded because of the wide fluctuation of values since the War and the variation in exchange. The data were found to be useless for present-day reference. The principal additions to the book are in connection with colloidity and adsorption; the theory of the precipitation of gold by charcoal; milling in cyanide solution; flotation and cyanidation; zinc-box practice; the deoxidizing of solutions; counter-current decantation; aluminum, sodium sulphide, and charcoal precipitation; agitation and slime-settling equipment; and a large number of minor references to almost every phase of practice. Additional illustrations and tables have been included, and the appendix contains a brief account of the use of Martin's antidote for cyanide poisoning.

Petrographic Methods and Calculations. By Arthur Holmes. Thomas Murby & Co., London. 515 pp., ill. For sale by 'Mining and Scientific Press'. Price, $6.

Most of the volumes dealing with petrographic methods are almost wholly devoted to the optical properties of crystals and their application to the determination of minerals; the investigation of rocks by other methods does not appear to have received the same degree of attention, and in preparing this treatise the author has tried to produce a more evenly-balanced textbook, which should penetrate the petrological domain, and not merely skirt its borderland. As stated in the preface, an adequate treatment of all the subjects involved would far exceed the limits of a book of reasonable size; consequently, field work, on the geological side, and geo-physical research, on the experimental, have been discussed but lightly. By giving examples of results already achieved, and by directing attention to the problems and objects of petrology, an attempt has been made to animate the dry bones of practical methods with the stimulating spirit of research. The value and importance of petrographic methods in relation to industries have not been forgotten; and although the exigencies of space have prevented more than passing mention of economic application, it is hoped that this may prove sufficient to indicate to chemists, architects, engineers, and others that the methods of work devised by the petrologist are sufficient to attack many of the problems with which they are faced, and are worthy of greater recognition than they have received in the past. The contents of the book are as follows: I. Petrology; its scope, aims, and application. II. Specific gravity of minerals and rocks. III. Separation of minerals. IV. Optical examination of crushed and detrital minerals. V. Examination of detrital sediments. VI. Preparation of thin sections. VII. Micro-chemical and staining methods. VIII. Examination of thin sections. IX. Textures and structures of igneous and metamorphic rocks. X. Chemical analyses and their interpretation. XI. Graphic representation of chemical analyses. Appendix, with photo-micrographs.

Manual of Flotation Processes. By A. F. Taggart. McGraw-Hill Book Co., New York. 181 pp., ill. For sale by 'Mining and Scientific Press'. Price, $3.

According to the author of this treatise, who is professor of ore-dressing at the school of mines at Columbia University, its preparation and publication was prompted by a desire to counteract the spread of false conceptions concerning flotation concentration, to describe apparatus and methods of testing, and to give some generalizations from mill practice, by means of which the laboratory experimenter may be able to translate his results into practical operations on a commercial scale. A better understanding of the physical principles underlying flotation phenomena and of the diversity of flotation processes has been delayed for several reasons. The apparent complexity of the subject and the difficulties of investigation are sufficient to explain this to some extent; but much of it is chargeable to the stand taken by patent-owning corporations in their attempt to establish a monopoly on flotation processes. These companies have opposed steadfastly the dissemination of knowledge of the art on the part of employees and licensees, notwithstanding the moral and legal duty of a patentee to make full and truthful disclosure of all he knows concerning the subject-matter of his patent. By threats of litigation sown broadcast they have succeeded in causing a veil of secrecy to surround the operations of non-licensees; and by the maintenance of unreasonable claims that all flotation processes prior to that described in U. S. patent No. 835,120 were laboratory curiosities or commercial failures, and that those subsequently discovered were merely improvements of that process, they have caused the spread of wrong ideas.

It is explained that the experimental data upon which the distinction between pulp-body and bubble-column processes, maintained throughout the book, were collected under the author's direction early in 1919; and those upon which the essential condition of supersaturation of the liquid of the pulp with gas in pulp-body flotation concentration is predicated were obtained during the latter part of 1919 and early in 1920. Subsequent to the latter discovery the author explains that he came into possession of a copy of 'The Theory of Concentration Processes Involving Surface-Tension', by H. L. Sulman and H. K. Picard. These gentlemen are two of the patentees of U. S. patent No. 835,120. Their paper shows that they recognized, as early as 1907, not only the essential similarity between their own and the prior pulp-body processes, but also the importance, in these processes, of the condition of supersaturation with gas of the liquid in the pulp. This monograph has never been published; a paper on flotation was issued by Sulman in 1919, in which no mention of the similiarity is made, and in which the question of supersaturation is not discussed. In the first chapter the author defines flotation, discusses the properties of minerals that float, and the types of ores that are amenable to the process. Methods are described in orderly sequence, including skin-flotation, oil-flotation, and froth-flotation. The various classes of pulp-body-concentration processes are dealt with in detail; these involve chemical-generation, pressure-reduction, boiling, and agitation. Other subjects in the first chapter include differential flotation, the flotation of oxidized ores, flotation agents, conditions of operation, typical flow-sheets, step treatment, and variables of operation. The second chapter is concerned with the testing of ores, and this section is exceptionally complete. The third chapter deals with mill data, with condensed though adequate descriptions of the various types of flotation machines and accessory apparatus in use. A valuable feature of the book is the collection of flow-sheets of important flotation plants in the United States, arranged in uniform style and prepared with evident care. A number of illustrations are to be found throughout the treatise. The author's tables for recording the results of experimental flotation tests, which originally appeared in the 'Engineering and Mining Journal' of October 26, 1918, have been amplified, and notes have been added on the descriptive terms used. The book will undoubtedly take its place among the standard works of reference on the flotation process, or rather on the flotation processes, as Mr. Taggart prefers to describe the application of the various phenomena involved.

Handbook of Construction Equipment. By R. T. Dana. McGraw-Hill Book Co., New York. 850 pp., ill. For sale by 'Mining and Scientific Press'. Price, $6.

This volume takes the place of a new edition of the 'Handbook of Construction Plant', which was first published in 1914, and which was designed to help the man who has to buy, sell, or use construction plants. The trend of evolution in construction equipment is toward simplification in the design of each individual machine, and a more specific adaptation of such design to special uses. Consequently, the number of types of equipment is growing year by year, and each type, for its particular use, is more efficient than was its predecessor. It is necessary, therefore, that anyone having to do with construction equipment should be up to date in knowledge of what is available, what the equipment costs, and how it may be used. The following subjects are dealt with: General principles applying to equipment. Air-compressors. Asbestos. Asphalt plants. Automobiles. Backfilling machines. Bar-cutters. Barges and scows. Bars. Belting for power purposes. Bending-machines. Bins. Blacksmith-shop outfit. Blasting-machines and supplies. Blocks. Blueprint machines. Boilers. Buckets. Buildings. Cableways. Cars. Carts. Cement-gun. Cement-testing apparatus. Chains. Chain-blocks. Chutes. Concrete-placing equipment. Concrete-sidewalk and curb forms. Conveyors. Crushers. Derricks. Diving outfits. Drag-scraper excavators. Drawing-boards. Dredges. Drills. Electric motors. Elevating graders. Engines. Explosives. Fire equipment. Forges. Forks. Forms. Furnaces and kettles. Grinding-machines. Heaters. Hoisting-engines. Hoists. Horses and mules. Hose. Hydraulic-mining giants. Jacks. Lead. Levels. Lights. Locomotive cranes. Locomotives. Machine-shop outfit. Mixers. Motor-trucks. Paint-spraying apparatus. Paulins. Photography. Picks and mattocks. Pier and foundation equipment. Pile drivers. Piling. Pipe. Pipe-line tools. Plant-rental charges. Plows. Post-hole diggers. Power. Pumps. Rails and tracks. Rakes. Refrigerating plant. Rivetting-guns. Road-making equipment. Rollers. Rope. Sand-blast machine. Sand and gravel washers. Saws. Scales. Scorifiers. Screens. Shovels. Skips. Sledges and hammers. Sprinklers. Stone-boats. Stump-pullers. Surveying and engineering equipment. Tampers. Telephones and telephone lines. Tents and tent equipment. Ties. Tool-boxes. Tow-boats. Tractors. Trailers. Transits. Trenching machines. Trucks. Unloading machines. Wagons. Wagon-loaders. Welding. Wheelbarrows. Winches. Appendix. The book is excellently illustrated and will be found invaluable for those who require a concise compendium of information on the subjects mentioned.

Elements of Fractional Distillation. By C. S. Robinson. 205 pp., ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

This treatise has been written to explain the principles of fractional distillation and to illustrate them with selected illustrations. It is neither a complete text-book on the subject nor an encyclopedia, but an introduction to the study. It is to be followed by another volume that will deal with the general practice of fractional distillation and its application to industry. The present volume is divided into five parts. The first deals with fractional distillation from the qualitative standpoint of the phase rule. The second part discusses some of the quantitative aspects from the standpoint of the chemical engineer. The third part discusses the factors involved in the design of distillation apparatus. Part four gives a few examples of modern apparatus, and in the last section there are useful reference-tables that have been compiled from a number of sources. The contents are as follows: Introduction. I. The phase rule. II. One-component system. III. Two-component systems. IV. More complex systems. V. Gas laws. VI. Solutions. VII. Concentrated solutions. VIII. Simple distillations. IX Fractionation. X. Rate of fractionation. XI. Discontinuous distillation. XII. Design of a continuous still. XIII. Fractionating column. XIV. The condenser. XV. Accessories. XVI. Continuous distillation. XVII. Ammonia. XVIII. Benzolized wash oil. XIX. Methyl alcohol. XX. Ethyl alcohol. Appendix.

Switching Equipment for Power Control. By S. Q. Hayes. 470 pp., ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $4.

This is the first book that has appeared dealing adequately with the subject of modern switchboards and switching equipment, which together form an essential part of any plant designed for the production or distribution of electric energy. Its preparation has been based to a large extent on articles written by the author, which have appeared in Pender's 'Handbook for Electrical Engineers' and in various trade publications. The main object of the book is to furnish the switchboard operator with the information that will help him to keep the equipment in good operating condition. It will also be of value to those who are responsible for the selection and the installation of new material. Sufficient theory is given to explain the function and the limitations of the various devices described. The contents of the book are as follows: I. Switches. II. Automatic protection and fuses. III. Carbon-breakers. IV. Oil circuit-breakers. V. Relays. VI. Switchboard meters. VII. Lightning-transformers. VIII. Lightning-arresters. IX. Regulators. X. Industrial-control apparatus. XI. Switchboards. XII. Small d.c. and a.c. switchboards. XIII. Large switchboards. XIV. Hand operated a.c. switchboards. XV. Bus-bars. XVI. Breaker-structures.

REVIEW OF MINING

GOLD MINING ACTIVITY IN CANADA

The Porcupine district is full of activity. This is to be the Big Year, they say. The McIntyre is doubling its mill; the Hollinger is to crush 8000 tons per day; the Dome is increasing its output; the small mines that have been quiet since the War are busy preparing for the spring opening. At Kirkland Lake a similar revival is apparent. The Ontario Kirkland has just produced its first gold—a brick worth $20,000. The mine is reckoned another dividend-payer. At the Montreal Kirkland they are erecting the necessary buildings preparatory to a vigorous campaign of development.

CALUMET & ARIZONA

When directors of the Calumet & Arizona Mining Co. meet next week the usual quarterly dividend of 50c. will be declared, states the 'Boston News Bureau'. All during the dark days in the copper industry since the Armistice the company has continued dividends, paying $2 last year and $4 per share in 1920. Like Utah Copper, Calumet & Arizona was frugal with its war profits and has been able to maintain dividends uninterruptedly. According to the management, "we still are in hopes that the metal market will show distinct improvement during the remainder of the year, and that the resumption of operations will prove profitable to stockholders of the company". Although the fires were started under two reverberatories at the Calumet & Arizona smelter on February 1, no copper bullion will be ready for shipment until about the first week of this month. The rate of production after that will probably be about 3,000,000 lb. of blister-copper per month. As the ore-beds at the smelter are filled, no ore will be mined until April. Working forces at mine and smelter will be gradually built up to ensure production at the rate of 3,000,000 lb. monthly and for the continuation of necessary development work. There has been little change in the wages of miners from last year. Miners in the Bisbee (Arizona) district are today being paid $4.50 per shift, the same as during 1921. Although this is a reduction from the war-peak of $6.25 per day, there is legimitate basis for mining companies to effect another revision downward, to bring the wage-scale nearer that of the other camps of the country. Given a sustained production of 3,000,000 lb. of copper per month, or 36,000,000 lb. annually, Calumet & Arizona only needs to earn a profit of 4c. per pound to cover amply its current dividend of $2 per share on the 642,541 shares outstanding. This is a moderate per-pound profit and will entail little strain, for Calumet & Arizona is one of the low-cost copper producers of the country. On any substantial advance in the copper market from the prevailing quotation of 13 to 13¾c., the dividend schedule can be easily increased.

NEW WAR MINERALS CLAIMS NUMBER 700

Seven hundred war minerals claims have been filed with the War Minerals Relief Commission under the recent act of Congress amending the law, the time for filing claims having expired February 15. The Commission has awarded the Whitmarsh Mining Co. $226,348 and George H. Crosby, $22,517, both Minnesota manganese claimants.

NEW FLOTATION PLANT OF SILVER KING COALITION COMPANY NEAR COMPLETION AT PARK CITY, UTAH

The machinery has been 'turned over', and the finishing touches are being given to the new mill of the Silver King Coalition Mines Co. at Park City, Utah. It will be in active and regular operation soon after March 1, according to reports. This new flotation plant, which has a capacity of 450 tons per day, and replaces the old plant that was destroyed by fire on January 27 of last year, is, in the opinion of the officials of the company and the engineers who have examined it, typical of modern engineering skill and progress. Something of a record has been established in the construction of the plant, as it was on July 1 of last year before the wreckage of the old structure was cleared away and active work begun on the new equipment.

W. M. Ferry, managing director of the company, says: "During the last few months we have held down our production from the mine, shipping only enough first-class ore to enable us to get along. The first-class product is found in the same workings as the second-class, or milling ore, the result is that many of the stopes and drifts are filled with ore that will not be handled until the mill is placed in regular operation. During the last two years we have pursued a careful and conservative policy of development, numerous new bodies of ore have been opened up and I am confident that the property generally is in better physical condition today than it has previously been in the last seven or eight years. As soon as the plant is in shape for steady operation the output of the property will be increased, for, in addition to the mill product, we will be able to send down much more first-class ore than was deemed advisable during the period of mill construction".

ARIZONA

Oatman.—That Oatman is to benefit from the sensational discovery made by the diamond-drilling campaign in the Oatman United mine is evident: At least a dozen companies have resumed work, and probably twice that number will be added to the list within the next 60 days. Renewed activity was also stimulated by the discovery of high-grade ore on the Stoney and Ferra lease within 100 yards of the business centre of the town. The stoping of ore that will run between $50 and $60 per ton for the whole stope on the 700-ft. level of the United American, and a steady production of ore running from $30 to $40 per ton in the Telluride, has also helped to focus attention on Oatman.

Harvey N. Hammond, superintendent of the Oatman United, is reluctant about giving information regarding assays from the diamond-drill cores, especially from those in the big rhyolite dike. That high-grade ore has been found in some of the cores is admitted, but Mr. Hammond thinks that a few more drill-holes will give a better idea of how the gold is disseminated. That there will be much good ore produced from this rhyolite dike is sure, but the full extent of the orebody is yet to be determined. The quartz vein found on a contact between the rhyolite dike and the andesite has been proved for a distance of over 600 ft. along the strike of the vein, and for over 550 ft. in depth—212 ft. below the 600-ft. level and 338 ft. above that level. As indicated by present development this vein will average about 4 ft. wide and $20 per ton. Aside from the fact that such big orebodies have been found, the big feature of the Oatman United strike is that the ore is found in and against the big rhyolite dike. In the past the gold produced in Oatman came from fissures in the andesite.

The Stoney-Ferra lease on the Tom Reed is living up to reasonable expectations, although no quantity of high-grade ore has been found. A small shipment to the smelter gave returns of $4475 per ton, according to the lessees, and more of a similar grade is stored in the Tom Reed vault. About 30 tons that will run from $100 to $200 per ton was broken in the stope or on the dump on February 24, and more that is expected to go between $500 and $1000 per ton. Two shallow levels are being run, one at 25 and the other at 50 ft. in depth.

The United Eastern has been diamond-drilling for some time from its No. 3 shaft, but the results obtained have not been published. During the week the Tom Reed started diamond-drilling from the 725-ft. level in the Red Cloud claim, which is isolated from the rest of the holdings and is surrounded by United Eastern ground. Encouraging assays were reported, but no ore has previously been found in the Red Cloud.

Among others that have started to work, or are about to do so—most of them diamond-drilling—are Big Jim, Oatman Gold Combination, Argo, Gold Dust, Merry Widow, Sun Dial, Amalgamated, San Francisco, Highland Chief, Silver Trails Bonanza, Nellie, Lexington, Telluride, and Baltic.

CALIFORNIA

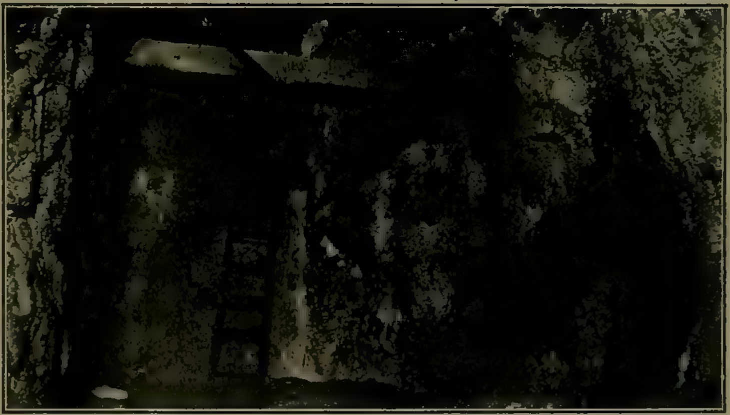
Angels Camp.—Rich gravel has been opened on the Slab Ranch mine. A large pump and other necessary equipment will be installed preparatory to developing the deposit.——Work is to be resumed at the Ozark gravel mine. Drifts will be extended from the shaft in an effort to find the main channel.——San Francisco people are said to have concluded a deal for purchase of the Rough Diamond property. The mine contains an extensive deposit of gravel showing excellent gold content.——A large deposit of cemented gold-bearing gravel has been demonstrated in the Victor group, and the owners are planning the erection of a gravel mill.——At Sanguinetti a large pump is being installed preliminary to development. The property is situated near Vallecito.

Forest Hill.—R. A. Nicol, John L. McCall, and capitalists from Oakland have taken a bond on the Independence Drift gravel mine four miles from here. The mine was formerly known as the Adams. Work has been started under the direction of Mr. McCall, who is superintendent of the mine.

Grass Valley.—It has been decided to sink the 1000-ft. vertical shaft at the Idaho-Maryland to 2400 ft. Work will commence at once. Lateral work is expected to open numerous ore-shoots. Recent work in the Dorsey winze has recovered the Idaho-Eureka-Maryland vein and has exposed a new vein in the lower levels. The new shaft will be connected with the older workings by a series of raises. Orders are to be placed immediately for additional equipment, and with the completion of the work the property is expected to become one of the regular gold producers of California. The property was acquired over three years ago by Bulkeley Wells and associates by whom several hundred thousand dollars has been expended on development and equipment.

Los Angeles.—The Jib mine was unwatered to the 200-ft. level on February 26; it will be unwatered to the 300-ft. level by March 10. Walter H. Wiley, who was with Marcus Daly for years in charge of his properties in Butte and elsewhere, will have charge of the sampling.

Sonora.—Production has started at the Springfield gravel mine. Several years have been spent in preparation. This included driving an adit nearly a mile long. The adit is now within 30 ft. of the shaft in which very rich gravel was exposed several years ago, but which could not be mined on account of excessive water. Medium-grade gravel is being washed now, but richer material will be mined soon.



Stopes in the 200-ft. (Above) and 300-ft. Levels of the Jib Mine

Weaverville.—The American-Italian Hydraulic Mining Co. has acquired a lease of 10 acres on the Paulsen ranch, held by the Bablew Mining Co. The new operators have arranged to work the ground with monitors, operating under a head of 100 ft. from the waters of Rush creek. A large deposit of gold-bearing gravel has been demonstrated and hydraulicking will start as soon as the banks are loosed by dynamite.——The Gardella Dredging Co. is installing equipment on its dredge on the Paulsen ranch and expects to begin gold production by July. The severe winter has hampered the shipment and installation of equipment. The company controls a large acreage of proved placer ground.——Several placer companies, including dredging, hydraulic, and drift, are preparing to resume mining along the Trinity river and tributary streams. The active territory includes areas near Weaverville, Junction City, Minersville, and other noted old camps.

COLORADO

Creede.—A shipment of ore averaging $75 per ton was made last week by the Wabash Mines & Power Co. from the new strike on the Monon.——Morgan and Sloan, lessees on the New York, are shipping 100 tons weekly from that property; the ore is of average grade.——Shipments were also loaded out from the Mollie S. of the Mid-West Mining Co. and from the Commodore mine.——The Reno lode-mining claim on McKenzie mountain at Sunnyside has been sold by its owner, Dennis Brennan of Penrose, Colorado, to Harold M. Lusty. There is good ore in sight.

Cripple Creek.—Ore assaying as high as 25 oz. has been opened on Tenderfoot hill, in the Sangre de Cristo tunnel, and a shipment now being made ready is estimated at better than two ounces gold per ton. The property is under lease to the Heaton Leasing Co. of Denver.——Stuart Cox and associate lessees of the United Gold Mines Co. are shipping a good grade of ore from both the W. P. H. mine and Damon group on Ironclad hill.——Stratton estate lessees, operating through the Globe Hill or Chicago tunnel, have opened a good grade of mill-ore and are shipping to the Portland mill.——Block 8 of School Section 16, on the eastern slope of Bull Cliffs, is again active. The La Montagne shaft, that has been a producer in the past, has been leased to local miners who formerly worked on the property, and will be unwatered, as it is claimed ore is exposed below the present water-level.

The annual report of the Portland Gold Mining Co. shows production last year of $787,312 on company account and $217,982 by lessees. The loss on operations is reported at $46,435.

For the first nine months the output was at the rate of 17,000 tons monthly, but Perry G. Harrison, the manager, in his report states that profitable operations could not be conducted under present conditions, and in October plans were worked out and initiated for placing the property on a basis of 36,000 tons per month production. This increase in tonnage handled will automatically cut overhead expenses about in half; drastic reductions in mining and milling costs are expected.

Leadville.—The Canterbury Hill tunnel is now in close to 850 ft. with the breast in solid formation and the rock breaking well. The air-shaft, 725 ft. from the portal, is completed and ventilation is perfected. Rich silver ore has been discovered by lessees of the Garibaldi or Sunday tunnel. The vein exposed is three feet between walls.——Ore sampling $40 to $50 per ton has been opened by John Cortellini on the Golden Eagle, on Breece hill, operating through the Jay tunnel at a depth from surface of 1200 ft.——The Fortune mine on Little Ella hill has been leased and re-timbering of the shaft is now in progress.——Four sets of lessees on the Fanny Rawlins are mining ore of good grade and are shipping steadily.

Lead-silver ore in a strong vein has been opened on the Lydia property on Dyer mountain by E. Nelson and associate lessees. John Cortellini is driving a tunnel on the Lion placer in this section to connect with the Peerless Maud mine workings to the north, and lessees of the Long and Derry and Ontario mines are also driving tunnels to prospect the same territory.——Operations are shortly to be resumed at the Carlton-Griffiths property in the St. Kevin district and at the Hayden mine in Stray Horse gulch; the Louisville property is to be started by its owners, W. O. Reynolds and E. Hanifon.

Silverton.—The Caledonia mill in Minnie gulch, about eight miles from Silverton, was totally wrecked by a snow-slide last week. The Caledonia properties had been closed for the winter and were visited every few days by a caretaker, who on his last visit found a pile of iron and junk where the mill had been. The damage is partly covered by insurance, and it is expected the plant will be re-built.

IDAHO

Coeur d'Alene.—No. 3 tunnel of the Independence Lead mine at Mullan has opened ore of a mill-grade in a body 15 ft. wide, according to reports. Samples running from 7½ to 11% lead and from 2½ to 3½ oz. silver have been obtained. This grade puts this ore in the general class of the mill-heads of the Morning mine, which property adjoins the Independence Lead. In No. 2 tunnel, which has picked up the vein about 200 ft. higher on the mountain side, and has been driven on it diagonally, bunches of low-grade mill-ore were found. The company will run a drift tunnel on what is believed to be an extension of the Morning vein as it strikes across the Victor claims of the Independence, thence to the West Hunter group.

Five teams are hauling ore from the Sidney mine on Pine creek, to the smelter at Kellogg. The ore averages 40% lead, 6% zinc, and 28 oz. silver per ton. While lessees are taking out this ore important development is in progress in the main tunnel.

The Marsh Mines Consolidated, at Burke, has drifted 150 of the 400 ft. it must proceed to reach the line of its December claim, according to Edward Pohlman, president. The work was started at the 30th floor above the No. 3 tunnel of the Hecla, at Burke, and is proceeding in an easterly direction on the vein. Ground is being broken at the rate of 4 to 5 ft. daily; arrangements are being made for the employment of another shift. The depth attained is about 1200 ft. on the dip of the vein.

A settlement has been made by the smelter for the first carload of ore shipped from the new shoot on the Western Union mine. It showed a content of 29 oz. silver per ton and 33.2% lead. The car contained 31 tons and had a gross value of $56.92 per ton. The net value, after the deduction of freight and smelting charges, was more than $40 per ton, and the total net value was $1253, of which 25% goes to the company and 75% to the lessee. The lessee performs all the work and pays for supplies. All ore will be sorted hereafter.

Porthill.—Satisfactory results are attending development of the Idaho Continental mine, under the partnership of A. Klockmann and the Bunker Hill & Sullivan Mining company. The partnership was formed after the issuance of a new lease to Klockmann in July last. The lease is for five years and requires the payment of $9.50 per ton on concentrate and crude ore taken from the property by the lessee. The property is 26 miles from Porthill, and four miles from the Canadian boundary.

Two years is the time within which the new electrolytic-zinc plant is to be completed at Kellogg by the Bunker Hill & Sullivan Mining company. The work may be done in less time if the Star ores are available, through the completion of the new Star cross-cut, which is set to be ready in two years or less. The electrolytic-zinc plant is primarily for the Star ores, but will do custom work similarly to the company's lead-plant. This means much more to the Coeur d'Alene than merely a million-dollar addition to the company's plant, for there are many zinc mines in the Coeur d'Alene which cannot be profitably worked until the plant is finished.

Talache.—A carload of ore averaging $110 per ton in gold, copper, and silver has been shipped from the Bluebird mine, according to reports.

NEVADA

Virginia City.—Indications are multiplying that the Comstock lode is to be the scene of a mining boom before the end of the summer season. The latest corporation to enter the local field is the Silver Hills company, controlled by W. J. Loring and associates. The Silver Hills has acquired the Buckeye Consolidated group, on the south end of the Brunswick-Occidental lode. It is the plan of the new owners to unwater the shaft, install modern equipment, and sink the shaft to greater depth. W. C. Ralston, San Francisco mine operator, states that work is to be resumed at the old Julia Consolidated in the immediate future. The Julia was formerly a noted producer and a popular favorite on the San Francisco Stock Exchange with pioneer traders.——The tunnel of the United Comstock company is reported to have entered a new and massive lode. The management is preparing for extensive development work, including opening of veins cut while the tunnel was being driven to its objective.

UTAH

Alta.—George H. Watson, president and manager for the South Hecla Mines Co., the largest company in the district, states that the amount of ore exposed in the various Alta properties is the largest in the history of the camp, and that more well-directed and systematic development work is being carried on than ever before. Fifteen four-horse teams are hauling ore from the various mines, in spite of the deep snow. A station is being cut in the Rustler ore-shoot, which lies at the junction of the Rustler vein and a quartzite-lime overthrust contact. At the point where the station is being cut the ore is 6 ft. wide. The principal metal in the ore is silver.

Eureka.—William Yusky and Joseph Bonovich have filed suit against the Chief Consolidated Mining Co. for $100,000 damages. It is alleged that several months ago the plaintiffs leased from the defendant company a certain portion of ground to be developed and mined on a royalty basis. It is further alleged that, after working the ground for some time, high-grade ore was found, and that the defendants thereupon claimed that the plaintiffs were extracting ore from ground previously leased to David Mills. To settle the dispute, the lease was modified and $3206, representing the value of ore extracted from the Mills ground, was returned to the company. In April 1921 the plaintiffs contend that the Chief Consolidated attempted to terminate their lease alogether by refusing to ship any ore mined by them. The plaintiffs contend they have been deprived of mining ore valued at $100,000, $25,000 of which would have been due the Chief Consolidated for royalties and $75,000 represents actual loss to the lessees.

Ore shipments for the week ending February 18 totaled 148 cars, as compared with 139 carloads for the previous week. The Tintic Standard shipped 59 cars; Chief Consolidated, 51; Grand Central, 11; Swansea, 5; Iron Blossom, 6; Centennial-Eureka, 4; Eagle & Blue Bell, 3; Dragon, 2; Gemini, 2; Bullion-Beck, 2; Tintic Mill, 1; Empire, 1; Victoria, 1. Small shipments from the Eagle & Blue Bell and Victoria mines are due to the walkout of employees on February 9, as a protest against a reduction of 50c. per day in wages. The difficulty was amicably settled on February 15 and the properties are again operating on a normal basis.

Milford.—The Beaver Copper Co. resumed work at its property on March 1. No work was done during 1921, except a small amount of mine-timbering. Development will be resumed in the east drift, which will be driven ahead to open the intersection of the Wasatch fissure with Fissure No. 1. At present small bunches of silver-lead ore are found in the face of the drift.

Park City.—A special meeting of the stockholders of the Silver Shield Mining & Milling Co. has been called for the purpose of voting on the propositions of increasing the capitalization and changing the name of the company. The company recently turned all of its Bingham holdings over to the Bingham-Galena Mining Co. It is proposed to change the name of the Park-Utah Extension Mining Co. and to acquire the Avondale property in the eastern part of this district. The recent gratifying developments in the Park-Utah mine have aroused interest as to possibilities of further ore-discoveries in that section. Harry Joseph, formerly manager of the Silver Shield, is a part owner in the Avondale property. It is proposed to make the capitalization of the new company 2,000,000 shares, as against the present capitalization of 300,000 shares for the Silver Shield company.

Ore shipments from this district for the week ending February 18 totaled 2662 tons of which the Judge allied companies shipped 1523; Silver King Coalition, 661; and Ontario, 478.

Wendover.—The Fluride Mining Co. has begun development of its holdings on Wildcat mountain, about 100 miles west of Salt Lake City and 20 miles from Fish Springs, an old mining camp, according to O. E. Anderson. Anderson states that at a depth of 50 ft. silver and copper ore was found, assaying as high as $112 per ton. One shipment has been made which netted the company $48 per ton. The company also owns an excellent deposit of fluorspar. Recently a shipment was made to the Utah Iron & Steel Co. The company has on hand about 500 tons, which has a market value of approximately $10,000.

BRITISH COLUMBIA

Ainsworth.—The Florence Silver Mining Co. has shipped the first load of concentrate under its contract with the Pacific Color Manufacturing Co., which has just got its new plant for the manufacture of pigments, at Chilliwack, to the producing stage. The contract calls for a concentrate containing 60% of lead, and the shipment that was sent from here contained 67.6%. The color company expects to use five tons of this concentrate daily until summer, when additions that are being made to the plant will enable it to use double that amount.

Nelson.—Though the Ivanhoe mill was not tuned to capacity until the second week in the month, during January the Silversmith Mines, Ltd., shipped 350 tons of concentrate to the Bunker Hill & Sullivan smelter, at Kellogg. The shipment averaged 67% lead and 106 oz. silver per ton. This was a gravity concentrate; the flotation department of the mill is not yet completed. It is expected that in future the mine will produce about 400 tons of concentrate per month. The ore-shoot, which has been exposed on No. 5, 8, 10, and 11 levels, averages 7 ft. in width and 450 ft. in length. The shoot has not yet been defined on No. 6 and 7 levels. At the present time all the mill-feed is being taken from the No. 8 level.

Prince Rupert.—Extremely cold weather is holding water in the mountains, and has so diminished the Granby company's power supply that operations at both mine and smelter have had to be curtailed; at the present time only one furnace is in commission. Work will be re-started as soon as power is available.——The owners of the Lion group, near Alice Arm, are taking out 20 tons of ore for a trial shipment to the Tacoma smelter.

Vancouver.—The local branch of the Canadian Institute of Mining and Metallurgy held a most successful meeting on February 13, 14, and 15. Unfortunately the meeting clashed with the North-West Mining Convention, at Spokane, and consequently many members from the Kootenay district were unable to attend; still, there was an excellent attendance, many good papers were read, and there was a general feeling of optimism with regard to the immediate future of the mining industry in the Province.——Part of one of the C. P. R. piers collapsed on the evening of February 18 under the weight of blister-copper that was piled on it, awaiting transportation to New York, and 885 tons of copper dropped into Burrand inlet. It will be possible to salvage most of the metal. It was the railway company's intention to destroy the pier as soon as the new pier, now under construction, was finished. The copper was the property of the Granby company.

Vernon.—The Progressive Mining Co. is opening a lode of gold ore near Okanogan Landing.——The old Morgan mine, at the head of Cherry creek, is being re-opened.

Victoria.—The following mining and metallurgical companies recently have been incorporated: Marine Iron Works, Ltd., Victoria, $25,000; Seymour Oil Co., Ltd., Victoria, $1,000,000; Dominion Mines, Ltd., Victoria, $60,000; Lanark Mining Co., Ltd., Vancouver, $200,000; and Port Alberni Gold Mining Co., Vancouver, $500,000.

ONTARIO

Cobalt.—The attention of prospectors is being directed to the area lying between Cobalt and South Lorrain, which it is believed may contain deposits of silver ore. The supporters of this theory point to the fact that with heavy bodies of ore occurring on the Violet and O'Brien mines in Cobalt and with promising silver discoveries along the chain of lakes extending southward as far as Goodwin lake, this may prove to be the connecting link between Cobalt and the South Lorrain district. Most mining men are disposed to be skeptical, but quite a number of prospectors will explore this area during the summer.

Kirkland Lake.—It is reported that the McKinley-Darragh of Cobalt is taking over the Bidgood mine, in which officials of the McKinley-Darragh are personally interested. Underground developments on the Bidgood have lately been highly favorable, the gold content of the vein being drifted on at the 400-ft. level, showing an increase of at least 20%.

A deal for the Elstone-Duncan property has been closed and it is planned to re-organize the company with an inincreased capitalization. The property, which has encouraging surface showing, is in line with the route of the extension of the Kirkland Lake highway to Larder Lake.

Porcupine.—The Northern Canada Power Co., which recently secured the right to develop power at Sturgeon Falls on the Mattagami river, 28 miles north of Porcupine, has begun the work of clearing the way for the transmission-line and will start active operations on development as soon as possible. It is stated that power will be available for delivery at Porcupine within nine months from the commencement of the work. The assurance of an additional supply of 7000-hp. will give a great stimulus to the expansion of the gold-mining industry.

The Hollinger Consolidated has ordered from the Oliver Continuous Filter Co. of New York and San Francisco six 14 by 16-ft. oscillating-type Oliver filters and the necessary equipment. Some months ago one of these filters was installed and was found to work satisfactorily, effecting a practically complete recovery. The filters will be placed at the lower end of the present cyanide plant to take the under-flow from the Dorr tanks and will have a capacity of 4000 tons of dry slime per day.

It is understood that British capital is being interested in the Gold Reef mine, which was closed some years ago and has remained idle owing to high operating costs. Now that economic conditions are more favorable there are good prospects of its being re-opened.

Percy E. Hopkins, Geologist of the Ontario Department of Mines, in a report on Ontario gold deposits, states that the Dome Mines has sufficient ore blocked out to keep the mill running at capacity for three or four years. The company has not for some years presented any statement of ore-reserves, hence the statement of Mr. Hopkins is of special interest, indicating blocked-out ore to the approximate amount of 2,000,000 tons.

Port Colborne.—The International Nickel Co. is dismantling its refinery at Bayonne, New Jersey, and transferring the machinery and equipment to the Port Colborne refinery, where all the work of refining the output of the Sudbury mines of the company will be done in future.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

Paul Hilsdale, of Eureka, Utah, is in New York.

G. F. Carr, of Tonopah, Nevada, is at Morenci, Arizona.

S. Herbert Williams has returned from New York to Ely, Nevada.

Marc L. Latham has returned to Oakland from Angels Camp, California.

E. R. Richards, of Berkeley, is at Callahan, in Siskiyou county, California.

F. C. Buckingham has moved from Bayhorse, Idaho, to Seattle, Washington.

R. R. Belknap, recently of San Jose, California, is now at Inspiration, Arizona.

George M. Fowler has moved from Butte, Montana, to Salt Lake City, Utah.

H. W. Hardinge left on the 'Baltic' from New York on February 15 for Europe.

Claude E. Amidon, of the Cornucopia Mining Co., in eastern Oregon, is here on a visit.

P. L. Guppy, assayer and chemist at Grandview, Washington, has moved to Silver City, Nevada.

Edgar E. Barker has sailed for Peru, and expects to rereturn to New York about the middle of April.

R. G. Knickerbocker sailed from New York on February 18 on his way to the Famatina mine in the Argentine.

Glenville A. Collins, managing director of the Drum Lummon Mines, Ltd., Hartley, B. C., has gone to Montreal.

L. F. S. Holland is examining mines in Sinaloa and expects to return to Hollywood, California, about March 21.

Walter Fitch, president of the Chief Consolidated Mining Co., at Eureka, Utah, is at Coronado Beach for a few weeks.

G. Cleveland Taylor, U. S. Mineral Surveyor for California, has moved his office from Redding to Randsburg, California.

Eugene Van Esse, who has been at the Busanga tin mine at Haut Katanga, South Africa, has returned to Brussels.

C. P. Browning, formerly superintendent of the Britannia mine, on Howe sound, British Columbia, has been made general manager.

D. H. Angus, manager for the Bidgood Gold Mines, at Kirkland Lake, was elected to the board of directors at the recent annual meeting.

W. M. Archibald, superintendent of the Consolidated Mining & Smelting Co. mines, is confined to his house, at Rossland, B. C., on account of illness.

Jesse J. MacDonald has severed his connection with James Irving & Co. in order to engage in private practice, with offices at 1116 Georgia street, Los Angeles.

John G. Barry, formerly of the Geological Department, Massachusetts Institute of Technology, and now mining geologist and engineer of El Paso, Texas, recently returned after completing an extensive geological study in the region of Parral, in Chihuahua, Mexico.

Schuyler Lawrence died at Wysox, in Pennsylvania, on January 9, after a year's illness. He was born at Topeka, Kansas, in 1864, the son of the then Secretary of State for Kansas. In 1882 he went to Mexico as engineer to participate in the building of the Mexican Central railroad. Later he engaged in mining, his operations being centred in Chihuahua, and chiefly in the Santa Eulalia district. Soon after the revolution of 1910 he left Mexico with his family and settled at Wysox. During the War he was in charge of the Intelligence Department of the Mexican division of the War Trade Board, where his efficient work received high praise.

THE METAL MARKET

METAL PRICES

San Francisco, February 28

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	13—13.75
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$90
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.50—7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

February 27.—Copper is dull and easy. Lead is active and firm. Zinc is quiet and steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Feb. 21	64.87½	33.62½	Jan. 16	66.06	32.31
" 22 Holiday		33.12½	" 23	65.27	34.90
" 23	64.37½	33.00	" 30	65.46	35.06
" 24	63.50	32.62½	Feb. 6	66.35	35.00
" 25	63.50	32.62½	" 13	65.75	34.22
" 26 Sunday			" 20	65.44	34.23
" 27	63.75	32.50	" 27	64.00	32.92

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	132.77	65.95	65.45	July	92.04	59.99	....
Feb.	131.27	59.55	....	Aug.	96.23	61.59	....
Mch.	125.70	56.08	....	Sept.	93.66	66.22	....
Apr.	119.56	59.33	....	Oct.	83.48	71.00	....
May	102.69	59.90	....	Nov.	77.73	68.24	....
June	90.84	58.51	....	Dec.	64.78	65.76	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Feb. 21	12.75	Jan. 16	13.62
" 22 Holiday		" 23	13.54
" 23	12.62½	" 30	13.48
" 24	12.62½	Feb. 6	13.29
" 25	12.50	" 13	13.17
" 26 Sunday		" 20	12.88
" 27	12.50	" 27	12.60

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	19.25	12.94	13.54	July	19.00	12.46	....
Feb.	19.05	12.84	....	Aug.	19.00	11.71	....
Mch.	18.49	12.20	....	Sept.	18.75	12.03	....
Apr.	19.23	12.50	....	Oct.	16.53	12.66	....
May	19.05	12.74	....	Nov.	14.63	13.07	....
June	19.00	12.83	....	Dec.	13.18	13.54	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Feb. 21	4.70	Jan. 16	4.70
" 22 Holiday		" 23	4.70
" 23	4.70	" 30	4.70
" 24	4.70	Feb. 6	4.70
" 25	4.70	" 13	4.70
" 26 Sunday		" 20	4.70
" 27	4.70	" 27	4.70

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	8.65	4.96	4.70	July	8.63	4.75	....
Feb.	8.88	4.54	....	Aug.	9.03	4.40	....
Mch.	9.22	4.06	....	Sept.	8.08	4.61	....
Apr.	8.78	4.32	....	Oct.	7.28	4.70	....
May	8.55	5.01	....	Nov.	6.37	4.70	....
June	8.43	4.57	....	Dec.	4.76	4.70	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	62.74	35.94	32.04	July	49.29	27.69	....
Feb.	59.87	32.16	....	Aug.	47.60	26.35	....
Mch.	61.92	28.87	....	Sept.	44.43	26.70	....
Apr.	62.17	30.36	....	Oct.	40.47	27.70	....
May	54.99	32.50	....	Nov.	36.97	28.93	....
June	48.33	29.39	....	Dec.	34.12	32.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Feb. 21	4.82½	Jan. 16	5.11
" 22 Holiday		" 23	5.04
" 23	4.85	" 30	4.93
" 24	4.85	Feb. 6	4.85
" 25	4.85	" 13	4.84
" 26 Sunday		" 20	4.85
" 27	4.85	" 27	4.85

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	9.56	5.86	5.05	July	8.18	4.41	....
Feb.	9.15	5.34	....	Aug.	8.31	4.69	....
Mch.	8.93	5.19	....	Sept.	7.84	4.74	....
Apr.	8.76	5.37	....	Oct.	7.50	5.09	....
May	8.07	5.37	....	Nov.	6.78	5.18	....
June	7.92	4.96	....	Dec.	6.03	5.24	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
Jan. 31	50.00	Feb. 14	50.00
Feb. 7	50.00	" 21	50.00
		" 28	50.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	89.00	50.00	50.00	July	88.00	47.75	....
Feb.	81.00	48.75	....	Aug.	85.00	47.50	....
Mch.	87.00	45.88	....	Sept.	75.00	47.50	....
Apr.	100.00	46.00	....	Oct.	71.00	46.25	....
May	87.00	50.00	....	Nov.	56.00	40.40	....
June	85.00	49.50	....	Dec.	52.50	49.50	....

THE EMPLOYEE AND THE EMPLOYER ARE ENGAGED IN COMMON ENTERPRISE

Waddill Catchings, a director of the Studebaker, Endicott Johnson, Underwood Typewriter, B. F. Goodrich, and several other large industrial corporations, in the February 'Atlantic Monthly', discussing the problems of labor and capital, says, inter alia, that the labor union is a militant organization and aims to get results by force, not necessarily physical force. The strike is the great weapon, and to make it more effective the labor union opposes law and order. Recently the American Federation of Labor announced the determination that, under certain circumstances, where the labor union disapproved of the court's decrees, they would be resisted, "whatever may be the consequences". Not only does the labor union oppose incorporation, but it endeavors to secure exemption from long-established laws imposing responsibility for collective action.

The labor union, says Mr. Catchings, seeks to get more for the workman and to make it possible for him to work less. No amount of pay is satisfactory if more can be obtained. The union seeks to limit output. It opposes the piece-work system with its utmost power and vigor. All efforts to develop a common enterprise are opposed. The weapon is the strike. The goal is more pay, less work. For years the railroads made little effective resistance to union demands; for, whatever the cost, the public paid. It is only recently, since freight-rates have been so increased as manifestly to destroy industry, that the railroads have learned the importance of economical management. Now it is a question whether the unions are not so great in power that efficient management cannot be established.

During the present period of depression the employers will naturally gain strength and will offset much of the advantage gained by the union during the War. But the time will no doubt come when the advantage will again be with the union. Thus the struggle will continue. The most serious obstacle to sound constructive effort in solving this great industrial problem is that college professors, and other thoughtful men outside of industry, favor the labor union in a struggle, the underlying conditions of which they do not yet understand.

Thoughtful men must in time see that what is needed is common effort. Production is clearly the true purpose of industry; employer and employee are inevitably engaged in a common enterprise. Fair wages, hours, and working conditions are questions of fact, to be decided as such. This principle demands that the employer shall not force upon the employee wages, hours, and working conditions merely because he has the economic power to do so.

In March 1918 the Standard Oil Co. of New Jersey invited refinery employees to elect representatives to confer with the management. All labor questions have since been determined in conference. In any meeting the representatives of the company are never more numerous than the employees' representatives present. The board of directors is the final authority, but in actual practice all matters are harmoniously settled in joint conference. Of course the unions fight all such plans adopted by the Standard Oil Co. to the utmost. If wages, hours, and working conditions are to be determined fairly as questions of fact, there is no need of the unions. There is no longer a struggle.

MONEY AND EXCHANGE

Foreign quotations on February 28 are as follows:

Sterling, dollars,	Cable	4.42¾
	Demand	4.42¼
Franc, cents:	Cable	9.17
	Demand	9.15
Lira, cents:	Demand	5.30
Mark, cent:		0.45

Eastern Metal Market

New York, February 22.

The markets have varied as to activity during the last week; some are fairly active and others stagnant.

Buying of copper continues very light and prices have again declined to new levels on this movement.

Sales of tin have been large, but prices have fallen.

The lead market has been active but there has been no change in prices.

Zinc is in poor demand, but prices are fairly steady.

IRON AND STEEL

Increased pig-iron and steel making is the outstanding factor of the week; it is the response to necessity buying and the purchases of railroad cars and track material of the past month.

The Steel Corporation is operating at better than 50%; but business accumulated by the independents has shortened the gap between their scale of operations and that of the corporation. The February production rate promises to exceed measurably the January output, which in steel was 46½% of capacity.

An unexpected development was a well defined effort to stabilize pig-iron prices. The demand for bridge and building construction is indicated by fresh projects involving 22,000 tons and the awards aggregating 14,000 tons. January's business in fabricated structural steel, 12,100 tons, was at a rate of 40% of the country's capacity and is barely 13% under the January average for 10 years.

COPPER

There has been no improvement in demand but there has been a further softening in prices to new low levels for the year. Electrolytic copper for February-March delivery is available and has been sold in small quantities from 13 to 13.25c., delivered, or 12.75 to 13c., New York or refinery, but large quantities from large producers cannot be bought as low as this. Sales are made largely by dealers and small producers who for one reason or another are making offerings down. It is believed by some that the low point has been reached because sellers can hardly go lower without making undue sacrifices. Very little is heard of export demand, but it is interesting to note that official data for 1921 show that exports of refined copper in that year were larger than in 1919 or 1920. The 1921 total was 596,117,247 lb., against 438,160,818 lb. in 1919 and 551,226,793 lb. in 1920. Last year Germany took 233,072,479 lb., over 39%, while in 1919 she bought only 6,831,400 pounds.

TIN

The last week has been fairly active, at least on February 15, 16, and 17, on which days good sales of Straits tin, mostly future shipment, were made. On February 15 about 400 to 500 tons changed hands, with consumers the principal buyers. On February 16 about 150 tons was sold to consumers and on February 17 about 150 tons to consumers and dealers. The market has sagged, however, practically each day until yesterday, when spot Straits was quoted at 29.25c., New York. Monday, however, was an inactive market, the break to under 30c. being largely due to a sharp decline in the London market on Monday, February 20, due to the liquidation of a Dutch syndicate. It is stated that on Monday, Banca tin was offered for shipment from England or Holland at 29c., delivered, New York. Quotations on the London market yesterday were £140 per ton for spot standard, £141 17s. 6d. for future standard, and £142 15s. for spot Straits, all about £12 per ton below prices a week ago. Arrivals thus far this month have been 2260 tons, with 7835 tons reported afloat.

LEAD

A fairly good business is reported to have been transacted in the last week, amounting to several thousand tons, mostly for delivery in March and to consumers in various lines of business. Prices are firm and unchanged at 4.70c., both New York and St. Louis, as that of the leading interest and 4.40c., St. Louis, and 4.70 to 4.75c., New York and Eastern point, as that of the independents.

ZINC

The market is not yet awake from its lethargy, and sales are confined to small lots for early delivery to meet consumers' immediate needs. Quotations for prime Western are unchanged at 4.50c., St. Louis, and 4.85c., New York, for early or February-March delivery. The fact that this quotation has prevailed for several weeks is the principal encouraging feature.

Exports for 1921, according to official data just made available, were at the low point of 4,785,657 lb., against 204,354,308 lb. in 1920 and 243,830,348 lb. in 1919. Japan took 2,645,355 lb. of the 1921 exports, or nearly 60%.

ANTIMONY

The market is quiet and quotations are unchanged at 4.40c., New York, duty paid, for wholesale lots for early delivery, with jobbing lots at 4.50 to 4.70c. per pound.

ALUMINUM

The market is quiet and without feature. The quotation of the leading interest continues unchanged at 19 to 19.10c. per pound f.o.b. plant, for wholesale lots of virgin metal, 98 to 99% pure for early delivery, with the same grade obtainable at 17 to 18c. per pound, New York, duty paid.

ORES

The market is still very quiet. One dealer states that actual business has been for export to Europe and this is coming from ore in the hands of sellers who do not care to hold it any longer. Prices are around $2 per unit and higher, depending on the grade of ore.

Imports of tungsten ores in 1921 were 1441 gross tons, against 1740 tons in 1920 and 8400 tons in 1919. Of the 1921 imports, 704 tons was Chinese ore and 284 tons came from Hongkonk, with 148 tons from Chile.

Molybdenum: A slight improvement is reported but it is insignificant and quotations are unchanged at 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: No transactions are reported, but it is the general opinion that no high-grade foreign ore can be bought at less than 25 to 26c. per unit, seaboard.

Chrome: A little more inquiry is reported, but quotations are unchanged at $19.50 to $20 per ton c.i.f., Atlantic ports.

FERRO-ALLOYS

Ferro-Manganese: The market for both foreign and domestic alloy is on a basis of $62.50, seaboard, but buying is not heavy and is confined to carload lots for early delivery. Inquiries before the market total about 500 tons.

Spiegeleisen: In the absence of any stocks of 20% alloy, available demand for the 16 to 19% grade is fairly good, inquiries totaling 1000 tons, for which $30, furnace, is the minimum.

Ferro-tungsten: The market is dull and without feature, quotations being technically unchanged at 40 to 45c. per pound of contained tungsten, with the foreign alloy quoted at 50c. f.o.b. Atlantic ports.

Ferro-chrome: No improvement in business is noted and quotations are nominal at 12 to 14c. per pound of contained chromium, delivered in standard alloy, depending on the composition and other conditions.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.00 to 1.50
" " " " " carboys "	2.00 to 2.75
" " C. P., 9-lb. bottles, in barrels, per pound	0.23½
" " " bulk, in carboys, per pound	0.18½
" muriatic, com'l, in carboys, per 100 lb	2.25 to 3.25
" " C. P., 6-lb. bottles, in barrels, per pound	0.28½
" " " bulk, in carboys, per pound	0.22½
" nitric, com'l, in carboys, per 100 lb	7.25 to 8.25
" " C. P., 7-lb. bottles, in barrels, per pound	0.38
" " " bulk, in carboys, per pound	0.27¾
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.25 to 6.00
" powdered, in barrels "	5.50 to 6.50
" glass, ground, 30 mesh, cases, tin lined, per 100 lb.	16.50 to 17.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	27 to 37
Lead acetate, brown, broken casks, per 100 lb	16.00
" " white " " "	19.00
" " " crystals, per pound	0.20
" C. P., test., granulated, per 100 lb	17.50
" " sheet, per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
" com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per lb	0.08¾
Manganese di-oxide, bulk, Caucasian (85% MnO_2, – ¾% Fe), in casks, per ton	60.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.14½
" " " " granular " "	0.15
" " " " powdered " "	0.17½
" carbonate, calcined, in barrel lots, per lb	0.09 to 0.12
" permanganate, in drums, per pound	0.40
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in sacks, per 100 lb	2.50 to 3.00
" " " in barrels "	3.00 to 3.50
" bicarbonate of " "	2.75 to 3.50
" caustic, ground, 98% " "	5.25 to 6.00
" " solid " " "	4.30 to 4.75

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	375.00
Conduit, galvanized iron, ¾-in., per 100 ft	10.00
" " " 2-in. "	31.45
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	18.20
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	22.00
" " " 14, single-braid, rubber-covered " per 1000 ft.	7.70
Insulators, glass for telephone, No. 9 pony, per 1000	55.00
" " power, No. 14, per 1000	68.30
" porcelain, 6600 v., No. 44, per 100	19.25
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
" " " " solid, per 1000	20.20
" " " 3½ " "	69.20
" tubes, 5/16 by 3-in. "	9.05
" " ½ " 6-in. "	38.15
Sockets, weather-proof, molded, No. 60,666, per 100	27.60
Telephone wire, iron, size 12, half-mile lots, per 100 lb	8.75

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000; per 1000	14.11
" " electric, 6 ft., No. 6, in lots of 1000, per box of 100.	7.31
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb	1.95
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	18.00
" gelatine " " "	18.00
" ammonia " " "	17.00
Fuse, common, in case lots, per 1000 ft	7.22
" waterproof, triple tape, in case lots, per 1000 ft	9.01

FUELS

Coal, Utah steam, \$3.50 at mine, plus \$7.25 freight to California terminal points, in carload lots, per ton	10.75
Coal, blacksmith's, in carload lots, per ton	21.00
" " in small lots, per ton	24.00
Coke, in carload lots, per ton	25.00
Fuel oil, per barrel	1.50
Diesel oil, per gallon	0.04¼
Distillate " "	0.16½
Gasoline " "	0.22½

HARDWARE

Anti-friction metal, per pound	0.16
Babbitt, genuine "	0.42½
Brass sheets, half-hard and soft, per pound	0.24½
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
" solid " " "	0.11
Fish-plate bolts, ⅜ by 2-in., per 100 lb	7.90
Nails and spikes (20d to 60d base), per keg	4.00
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb	9.45
" cold punched " "	11.25
Picks, mining, 5-lb., per dozen	11.25
Shovels, carbon steel, No. 2, long handles, per dozen	15.00
Track spikes, ⅜ by 4-in., per 100 lb	4.65

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	3.25
Rails, steel, 16-lb., per 100 lb	3.69
Reinforcing-steel, per 100 lb	3.25
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	6.25
" flat " " " "	6.15
" flat, black iron " "	5.50
Structural T's, channels, angles, and beams "	3.25
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb	6.00
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	10.50
" " galvanized " " "	13.70
" " black " 4-in. "	45.00
" " " extra strong " "	78.75
Shafting, cold-rolled (2¼ to 3-in. base) "	4.65

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 27½%; extra strong cast-steel, 35%; plow-steel, 40%; blue-centre steel, 25%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue centre rope, per foot	0.375
Cast-steel rope, per foot	0.225
" " extra strong, per foot	0.240
Plow-steel rope, per foot	0.258

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 12 in. wide, per thousand feet (M)	75.00
Fir, common, base price, per M	28.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	32.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	45.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M	90.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	80.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	215.00
White pine " " " "	145.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, extra hard, 10-case lots, per case	6.30
Carbide, in 100-lb. cans, per can	7.35
Cotton waste, best grade, per 100 lb	14.50
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.17
" " " 2 (standard), per pound	0.16
Packing, flax, per pound	0.32 to 0.85
" sheet "	0.25 to 1.00
" steam or water, first grade, per pound	0.90
Silex lining, crated, per long ton	45.00
Tube-mill pebbles, Danish, selected (in bags), per long ton	25.00
Zinc-dust, in 250-lb. boxes, per 100 lb	8.75
" sheet, 36 in. by 84 in., No. 9 gauge, in ton lots, per 100 lb	12.25

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000, in carload lots, Livermore Star Brand	55.75
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb	2.65
Portland cement, in bags, per barrel of 380 lb	3.55
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb	4.33
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots; 52c. for cement in bags.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

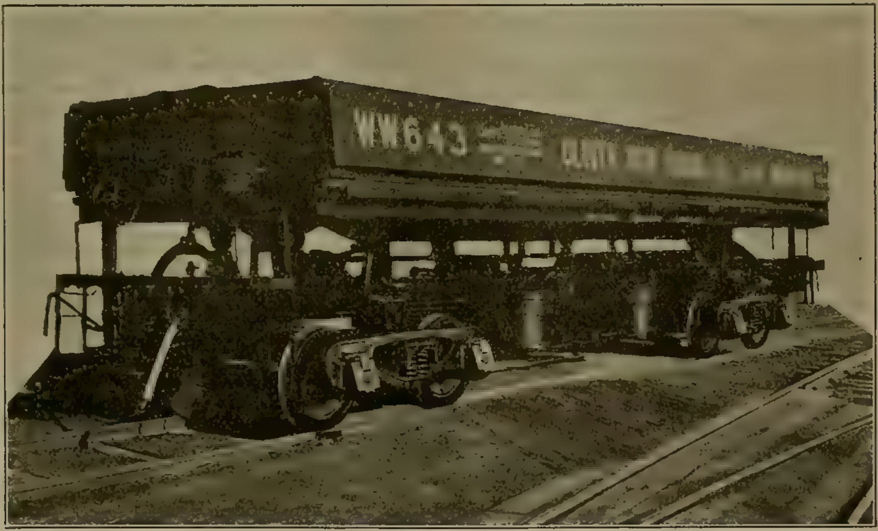
Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	\$25 to \$2000
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	10 to 15
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, powdered, per pound	3c. to 6c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	20 to 25
Mica, according to size, clearness, and cleavage, per pound	1 to 8
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, ground, commercial, per ton	24 to 26
Tin ore, not less than 60% Sn, per % Sn	4 to 6
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

IMPROVEMENT IN AIR-DUMP CARS

The requirements of mining operations have been responsible for much of the recent development in the larger sizes of air-dump cars. With steam-shovel contractors the 12-yd. size still is the greatest favorite, for obvious reasons; but for heavy stripping operations and handling low-grade ore between the mine and the mill, where permanent tracks can be established and maintained in first-class condition, the tendency has been toward larger and larger loading units. In building air-dump cars of 30-yd. capacity, for use on the Mesabi Iron Range, by the Oliver Iron Mining Co., which is a subsidiary of the United States Steel Corporation, the Western Wheeled Scraper Co. of Aurora, Illinois, was confronted with the desirability of distributing the dumping strain over the length of the car bed. In dumping 35 to 38 cu. yd. of heavy material, heaped into a 30-yd. car, the strain necessarily is very great. The manufacturers solved this problem successfully by installing two vertical cylinders instead of one, on each side of the 30-yd. car. The Western 25-yd. and 20-yd. cars, used in the Copper Queen and United Verde operations, are eight feet shorter in the bed and consequently the single-cylinder dumping mechanism is sufficient.



A 30-yd. Car Fitted with Air-Dumping Equipment at Both Ends

VOLUME V. WEIGHT OF DYNAMITE

Extra (ammonia) dynamite in 1¼ in. by 8 in. cartridges will run about 200 cartridges per 100 lb.; straight nitroglycerin dynamite about the same number. Compare any of these grades on a cartridge-count basis with Hercules Special No. 1 or Hercomite which are among the most recent brands of high explosives manufactured and introduced by the Hercules Powder Co. Hercules Special No. 1 averages about 270 cartridges 1¼-in. by 8-in. size, per 100 lb., and Hercomite, 300 to 310. In other words, when you buy 100 lb. of Hercules Special No. 1 you get about 70 more 1¼-in. by 8-in. cartridges than you would if you had bought Extra (ammonia) dynamite. This is an increase of 35%. If you buy Hercomite you get over 100 more, an increase in number received, of more than 50%.

A cartridge of Hercules Special No. 1 costs about 25% less than a cartridge of 35% Extra dynamite, and is even cheaper than a cartridge of 20% Extra dynamite. In fact, Hercules Special No. 1 and Hercomite are cheaper per cartridge than any other high explosives manufactured by the Hercules company.

Furthermore (note this carefully) it has been demonstrated by many tests on both small and large shots that Hercules Special No. 1 can frequently be used with complete satisfaction without increasing the number of cartridges per charge over the number of 35% or even 40% Extra dynamite cartridges that had been used before the change was made. In such cases a clear saving of approximately 25% is made by using Hercules Special No. 1. If you are now using 35%, 30%, 20%, or lower strength dynamites, you may save money by making the change. You may be able to do so if you are using 40%. True, Hercules Special No. 1 and Hercomite cost a trifle more per 100 lb. than 35% dynamite, but their cost per cartridge is less than that of 20% dynamite, and as stated above, Special No. 1 often replaces 35% and sometimes even 40% dynamite, cartridge for cartridge. Forget the cost per 100 lb. Figure on a basis of cost per cartridge and a comparison of work done per cartridge. In this way you will arrive at your true explosive cost. In many different sections of the country, Special No. 1 is replacing other grades of explosives for shooting small machine-drilled holes, and in blockholing, at a considerable saving to the operator.

It is not claimed that Hercules Special No. 1 will meet every need. For example, in blasting certain tight formations a concentrated explosive charge at the bottom of the drill-hole is necessary. In such cases 60% or higher strength dynamites are often desirable. Although a given weight of Special No. 1 contains approximately the same amount of explosive strength as 60% dynamite, yet due to its greater bulkiness Special No. 1 will fill a larger volume than an equal weight of 60% dynamite. In other words when comparing Special No. 1 with dynamite on an equal weight basis, Special No. 1 figures about 60% in strength but when comparing equal volumes, its strength is between 30 and 40%.

Explosives can be judged in two ways, namely, by their weight-strength and bulk-strength. In many cases where 40% and lower strengths of dynamite are now being used in rock blasting, the use of Special No. 1 will effect an appreciable saving. This includes work at open-pit mines, quarries, railroad and highway excavations, underground stoping, etc.

As previously stated, Hercomite costs even less per cartridge than Hercules Special No. 1 because it runs over 300 cartridges 1½ in. by 8 in. per 100 lb. compared to about 270 for Special No. 1, while 100 lb. of either may be obtained at the same price.

This makes Hercomite more economical than Special No. 1 on work for which it is suited. The truth is, that the common practice of using a unit of weight for buying dynamite and a unit of volume for its consumption, without considering the number of volume units (cartridges) obtained, is often a costly one to the purchaser. Many a man thinks that powder is powder and fails to make a careful analysis of the dynamite he buys from a standpoint of both volume and weight strengths. If this analysis of the subject has started the reader thinking along this line, it will have accomplished its purpose.

MERCO PRECIPITATION PROCESS

In designing a modern milling and cyanidation plant the metallurgist of today has the option of several different systems for crushing and grinding the ore and for its subsequent cyanide treatment. The sandy portion may be leached in various ways and there are numerous devices for treating and agitating the slime. Both pressure and vacuum slime-filters are available for separating the precious metal-bearing solution from the residue, and counter-current decantation, used in conjunction with filters, is found in the more recently designed plants, says a new catalogue published by the Merrill Company.

However, for recovering or precipitating gold and silver from cyanide solutions, no method has yet been found to compete successfully with the use of zinc, or alloys of that metal. The sodium sulphide precipitation at Cobalt and the charcoal precipitation at Youanmi, Australia, constitute the only known exceptions, and these methods have not proved applicable elsewhere. Electrical precipitation has been repeatedly tried, but power and operating costs are prohibitive and a 'barren' tailing cannot be obtained.

There are two distinct methods of carrying out zinc precipitation; for maximum efficiency both involve the preliminary use of the Crowe vacuum process in which the solutions are exposed to a high vacuum in a suitable receiver and practically all of the dissolved oxygen removed. The operation of precipitation is essentially one of 'reduction' by nascent hydrogen, formed in the solution by the precipitant. So long as dissolved oxygen is present it will immediately combine with the hydrogen; the whole operation of precipitation is simplified and cheapened by the simple mechanical elimination of this interfering element. Following this preparatory treatment the solutions are precipitated either by the Merrill process or on zinc shavings.

The Merrill precipitation process has long since become standard equipment in cyanide plants on the American continent. Used first by the Montana Mining Co., at the Homestake mine in South Dakota, the economies and obvious advantages of the process soon led to its use elsewhere, in a great many instances displacing zinc-boxes. Until the advent of the Crowe process, some difficulties were experienced in efficiently precipitating the extremely weak solutions used on the Rand in Africa. These solutions are low in gold and contain only traces of cyanide and alkali, and careful manipulation with additions of fresh cyanide and lead salts was necessary to obtain good results. The removal of dissolved oxygen has eliminated all of these troubles; perfect precipitation is obtained in Africa, as well as in America, and solutions containing less than 0.1 lb. of free cyanide (NaCN). 'Trace barrens' of under one cent are obtained with remarkably rich precipitates; on gold ores the raw product from the presses contains 30 to 60% bullion, on silver ores from 75 to 90%.

The precipitant for use with the Merco precipitation process is marketed under the trade name of 'Merrillite', and is an alloy-zinc dust of unusual uniformity and fineness. For the precipitation of gold solutions, the use of this precipitant is now almost universal, and even on silver ores, where the requirements are not so exacting, the higher efficiency and better-grade precipitates obtained with the Merco product have secured and hold the business of most of the silver cyanidation plants in Mexico and America. The two largest cyanide plants to be built during 1922 will be the United Comstock, on the old Comstock Lode at Virginia City, Nevada; and the New State Areas, on the Rand in South Africa. The former will have a capacity of 75,000 tons of ore per month and the latter an initial capacity of 50,000 tons. Both will use Merco precipitation, the Merrill process, and the Crowe vacuum process.

NEW BULLETIN REGARDING QUIGLEY PULVERIZED-FUEL SYSTEM

A new bulletin on the Quigley fuel systems, comprising methods of preparing, transporting, and burning of pulverized fuels has just been published by the Hardinge Co., 120 Broadway, New York.

This bulletin is known as No. 12 and treats the subject of pulverized fuels in a manner never before attempted. One of its distinguishing features is the fact that emphasis is laid upon the methods employed properly to prepare and burn powdered coal, instead of on a discussion of the pulverizer.

Aside from complete plant layouts, what they term as a Unit Milling Plant is described. This layout is radically different from anything ever before developed. The system comprises a method of pulverizing and transporting the coal to one or more furnaces in the same locality, at the same time securing positive regulation and continuous operation over extended periods. The cost of this unit is but a fraction of that of the larger systems where coal must be transported several hundred feet to a number of furnaces.

From the incomplete list of users shown in the back of the book, it is evident that the facts presented in this catalogue are backed by a considerable amount of experience, for not only does this list include companies in many classes of industries, but the range of capaciy for the complete pulverized-fuel plants is extreme.

This catalogue will undoubtedly be useful to the engineer designing power-plants or furnaces requiring considerable quantities of heat.

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DISSOLVED ACETYLENE

T. A. RICKARD, ... Editor

THE passing of John Branner will bring sadness to many; for he was of the men that not only do good work themselves but stimulate others to do so likewise. One of the greatly useful men of the world, Herbert Hoover, owed much to Dr. Branner, who was his friend and mentor when they were professor and student together at Stanford.

SPEAKING before the National Press Club, the President said that the outstanding experience of his first year in office was the change in his "conception of the Senate of the United States". That strikes a chord of sympathy in the breast of the average citizen. In the daily newspaper in which we read this speech of the President there appeared a cartoon in which Mr. Harding is depicted in the act of rolling up his sleeves prior to tackling an ugly blustering person labeled 'Senate', while Mr. Public stands by and says, "And if you need any help, Warren, let me know". Many a true word is said in jest.

ADVICES from Wolgan Volley, in New South Wales, indicate that an experiment on a large scale to distil shale-oil in situ has resulted satisfactorily. A correspondent in 'Chemical and Metallurgical Engineering' quotes from the 'Morning Herald' of Sydney to the effect that the shale in an old working was set on fire after having been protected and confined by brickwork, so that control and combustion could be regulated. It is reported that three days after the fire was started the flow of oil exceeded the storage capacity of the tanks that were available. The result is interesting and significant as pointing a way to the economical exploitation of deposits of shale.

IT will be remembered that the controversy between Mr. Karl Eilers and the Guggenheims was referred to a committee, headed by Mr. Henry Evans. This committee was to investigate and report on affairs of the American Smelting & Refining Company. The report is not ready and will not be ready before the second Tuesday in April, which is the regular date for the annual meeting of the company; therefore the meeting has been postponed until June. One of the causes of delay was that Mr. Elihu Root has been too busy as yet to review the Evans committee's report, in accord with an agreement between the parties to the controversy. Originally Mr. W. H. Taft was to have been the reviewer, but on his elevation to the Supreme Bench, Mr. Root was selected for the task.

OLD DAYS on the Comstock is the subject of an article that we publish in this issue. The reminiscences are those of a former Governor of Nevada, Mr. R. K. Colcord. He has been a miner most of his life, for he came to California from Maine in 1856, when 17 years of age. He mined first on Dead Man's bar on the Stanislaus river, in Tuolumne county—names all of which smack strongly of Bret Harte romance. Then he had charge of the Del Monte group of mines at Aurora, in Nevada, for H. M. Yerington. In 1859 he joined the rush to the Comstock, and after 25 years of "variegated experiences", as Mark Twain says, he entered politics so successfully as to be elected Governor of Nevada and thereafter Director of the U. S. Mint at Carson City. He is now 82 years of age, but still up and doing. We thank him for contributing to our columns.

WHETHER it be an honor to be quoted in the 'Literary Digest', we do not know for certain, but it does argue the writing of something that is of general interest. Therefore we accept the compliment paid to two members of our organization. The 'Digest' of February 11 reproduced the article by our business manager, Mr. C. T. Hutchinson, on 'Co-ordination, Cooperation, & Conference Inc.', appearing in our issue of January 7, and in the later weekly compendium of February 25 we find the article on 'Spraying with Atomized Metal', written by Mr. A. W. Allen and printed as an editorial in our issue of January 21. Mr. Hutchinson's article was a humorous analysis of the ways of big business, or, more accurately, the business that tries to put on the airs of bigness. Mr. Allen's contribution was based on facts taken from an article in 'The Compressed Air Magazine', and presented in a manner that made them acceptable and interesting.

CONSCIENCE money is seldom disbursed by corporate enterprises, because so few of them have souls. We are glad to note that there is one exception at least to the general rule, for the Eastman Kodak Company recently contributed voluntarily the sum of $182,770.60 to the Government. This amount represents the profit over and above 10% made by the company during the

War, for material supplied to the Aircraft Service of the War Department. Many other wealthy corporations found that no definite figures were available upon which anticipated costs could be based, so a liberal margin was allowed whereby a loss on the transaction was made impossible. The Eastman refund points a way by which many other corporation consciences may yet be salved, to the benefit of the Treasury. The Acting Secretary of War, in acknowledging the sum mentioned, expressed his appreciation of the patriotism evinced by the Eastman company; he added: "Such a wholesome and generous attitude might well be expected during war times, but with the lapse of three years since the Armistice, it is truly refreshing and inspiring to find such motives and high ideals animating a large business organization in its relation with the Government".

IT HAS been reported that the Chancellor of the Exchequer recently stated in the British House of Commons that it was the intention of the Government to permit the re-establishment of an unrestricted market for gold in London at the earliest date at which the state of exchange would render this course possible and desirable. "This", according to the New York 'Herald', "foreshadows the restoration of the gold standard throughout Europe, because England, as the clearing-house for European nations, will be obligated by the technicalities of the international money market to accept all foreign bills of exchange . . ., regulating the exchange by shipments of gold, so that these bills will be paid, as before the War, at a specified rate of exchange. A free gold market in England, it was explained by banking authorities, will mean stabilization of European exchange-rates and a consequent reliable price-level for American goods. Since the War, private interests in England could not ship gold to New York in payment of a debt. But with the establishment of a free gold market any Englishman possessing bank-notes can convert these into gold and ship the metal to New York. The British pound would thus be kept at par, which is \$4.8665." All of which indicates the return of normal financial conditions in England. The stabilization of the pound sterling will have a salutary effect on the currencies of other European countries. The absurdity of the wholesale issuance of paper money is at once made manifest when gold must be exchanged for bank-notes.

OIL to the amount of 24 billion barrels is estimated to be available from 317,000 acres of oil-shale land in Utah, according to statistics published in the 'Salt Lake Tribune' and vouched for by Mr. J. B. Jenson, shale-oil engineer. The immensity of this figure is best appreciated by comparison with the production to date of petroleum from all the oilfields of the United States. This total, according to the U. S. Geological Survey, is 5.47 billion barrels. Engineers for the Survey have estimated the remaining resources from wells to be 9.15 billion barrels, and this estimate is supported by prominent petroleum geologists. The probable rate of consumption of domestic oil is 600 million barrels per annum, which would indicate the exhaustion of the 'underground' supply within 15 years. Mr. J. C. Donnel, president of the Ohio Oil Company, speaking recently before the American Petroleum Institute in Chicago, said that of 248 oil structures, selected by competent oil geologists, in the Rocky Mountain region, 207 had proved unproductive, and that the drilling of them had entailed a net loss of \$20,000,000. Mr. Jenson emphasized the fact that the shale-oil exploitation incurs neither the heavy outlay for fruitless drilling nor the hazard of a brief productive period even when oil is found; the extent and richness of the shale can be determined accurately. The financial outlay for equipment and plant necessarily will be large, but Mr. Jenson is optimistic as to the time that will elapse before the production of shale-oil on a large scale is an accomplished fact.

DURING the past five years the Anaconda Copper Mining Company paid in the aggregate \$6,323,576 in taxes to the city, county, and State governments of Montana, according to Mr. Dan M. Kelly, of the legal staff of the company, who discussed the problem of taxation as it affects the mining industry, at a public meeting of Montana taxpayers, held at Billings recently. During the same period the total net return from the company's operations in Montana amounted to \$33,309,378, and two of the five years included were the most successful in the history of the company. As the 6¼ millions does not include any taxes paid to the Federal government it is apparent that for each \$100 that the company realized from its operations in Montana, \$19 was paid to defray the expenses of local government. Mr. Kelly took occasion to correct some erroneous impressions that are entertained by many not familiar with tax matters, as to the method used in assessing mining property in Montana. It is alleged frequently that the Anaconda Copper company pays taxes only when it earns a profit, this idea being the not inexplicable result of discussion of the tax on net proceeds. As a matter of fact the Anaconda Copper company paid taxes in Montana during 1921 on physical property appraised at \$59,193,130; the tax on this property was levied at the same rate and collected in exactly the same way as the taxes paid by any other property owner. It may be observed that on the first Monday in March, which is the date on which appraisement is to be made according to the Statute, the market value of the shares of the company was \$88,587,500. As only 61.6% of the property of the company is situated in Montana the market appraisal of the assets within the State was \$54,570,000, which is more than four million dollars less than the sum on which regular taxes were paid. It is true that the market price of the shares was less than half of what it was at the peak during the War; nevertheless the figures refute the belief fostered by some critics that a mining company pays nothing on the value of its mine-equipment, reduction plants, and such property unless the operations for the year are successful. Another misconception is that 'net proceeds' is synonymous with 'net profits'. Mr. Kelly emphasizes the difference by a simple illustration. Suppose a company purchase a mine for a million dollars, from which it can realize a net return of $200,000 per year for ten years. For the first five years the 'net proceeds' would be $200,000 per annum; in Montana, this would be subject to taxation, although as a matter of fact at the end of the period half of the mine is exhausted and no 'net profit' has been realized. Another phase of taxation in Montana is frequently ignored by those who are either unfriendly to the mines or who have given little thought to the subject. On the average the appraisal of real and personal property in the State is made on the basis of 30% of full or actual value. Since net proceeds of mines are placed upon the tax-roll at their face amount, the effect is to tax mining companies on more than three times the value of these net proceeds. In addition to the tax on physical assets and the regular tax on net proceeds, mining companies in Montana pay two additional State taxes. The first is the annual corporation license-tax amounting to 1% of the net proceeds of business in Montana, and the second is a mines license-tax of 1½% on the net proceeds of mining operations. The problem of taxing mines is most difficult; but the mining companies are entitled to one thing: the other taxpayers should know all the facts regarding the operation of the laws; they should apprise themselves of these facts before they condemn the companies as tax-dodgers.

INTERESTING interpretations of the Workman's Compensation Act of Utah appear in the recent findings of the State Industrial Commission in the case of the petition of Mrs. Elizabeth Westerdahl, the widow of John Westerdahl, who was superintendent of the Tintic Standard mine at the time he was killed on March 9, 1921. The facts seem to be that Westerdahl entered the general store at the mine at the time it was being robbed. He asked for a cigar, and, presumably believing that a joke was being played, ignored the command of the robbers that he raise his hands. One of the robbers shot and killed him on the spot. The store-building was owned by the company and was on mine-ground, but it was leased and the business was conducted by the lessee. Two of the Utah commissioners conclude that Westerdahl entered the store for the purpose of buying a cigar and that the shooting did not arise out of his employment, or occur in the course of the performance of his duties, as an employee of the company. They decide accordingly that the widow is not entitled to compensation, for the reason that the Commission has no jurisdiction in the case. The third commissioner is of the opinion that the position of a mine superintendent is such that he is always on duty while on the mine property. Evidence was introduced at the hearing to show that during the day preceding the evening of the murder Westerdahl had been searching for a former employee who had been discharged but who had not left the camp and that he had previously visited the store during his search. This member of the Commission maintains that the case was within its jurisdiction, but that it should be guided by the decision of the Supreme Court, by which a former award in favor of a claimant had been reversed. Westerdahl's death, he maintains, was the result of a wilful act by a third party at the time when the victim was performing his duties, but the motive for the shooting had not arisen from anything appertaining to his position as superintendent. There appears to have been no conversation between Werterdahl and the murderers regarding the affairs or operation of the mine; on this ground alone the third commissioner assents to the conclusion of his associates. Setting aside legal technicalities, we are inclined to believe that justice would dictate an award to the widow. There is every reason to believe that in a small community of one or two hundred persons the victim was known to the robbers because of his position as superintendent. They knew that he was a fearless and resolute man and that he was to a degree responsible for the safety and well-being of everyone in the community.

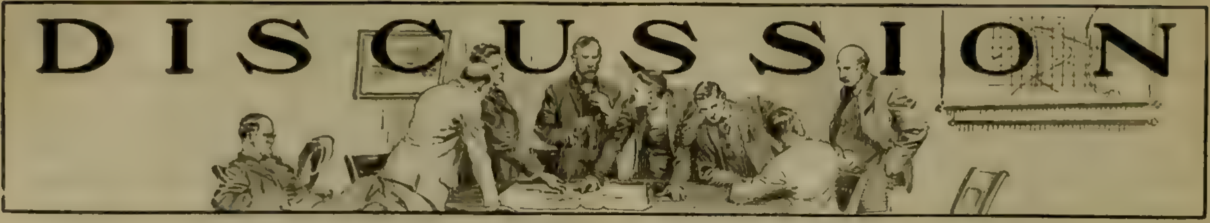
Class Legislation

At the recent annual meeting of the Institute, in an address by Mr. Ralph Arnold, the suggestion was made that an import duty on foreign oil should be levied for the purpose of protecting domestic producers "at times when foreign importations appear menacing". The "times" are likely to be continuous if the oil-producers are to decide when the foreign importation is "menacing". Such suggestions for special legislation—for Congressional action in favor of special classes and interests—are becoming common, and that is one reason why they are not opposed frankly or taken at their true intent. Mr. Arnold is a geologist who specializes in oil, but he is also a participator in the promotion of oil ventures. His name was prominent in the daily press recently in connection with a consolidation of oil interests in California. When he advocates an import duty on oil, he acts for his own interest and that of his associates—not for that of the Nation. Manifestly, at a time when we are told insistently by the Director of the U. S. Geological Survey that we are facing a depletion of our domestic oil resources, it is illogical to attempt to prevent the importation of oil. Surely if we desire to conserve our own supplies we should welcome oil from Mexico, for example. Indeed it is time for the public—meaning the tax-payers, more specifically—to realize how much special legislation is being attempted for the benefit of particular classes, all of whom naturally, by the process known as log-rolling in Congress, combine to support each other's schemes. We have been condemned by some mining men for our failure to give vigorous support to the McFadden Bill, on the ground that we ought to help our friends no matter whether we believed or did not believe that the gold bonus was a good thing for all the people of the United States. Sundry critics have demanded that we surrender our convictions on the issue or face the loss of their patronage. The reply to this can be guessed, easily. One of the chief arguments for the gold bonus, namely, that an increased production of the standard metal was needed to strengthen the reserve in the Treasury and to protect our currency system—has been rendered ridiculous by the logic of events, as we anticipated; for now our financiers are putting their heads together to devise a way to get rid of our enormous accumulation of gold, recognizing that it is desirable that it should be spread among the other countries in order to stabilize exchange and rehabilitate international commerce. In truth, a lot of nonsense was said and written on the McFadden bonus by people who saw only their own interest in the matter. We do not blame them for that—because it is human to protect oneself—but we do demur to the efforts that were made to silence honest criticism and to force honest thinkers to surrender their convictions on a matter of national importance. The gold-mining industry is now in the ascendant; it is becoming prosperous again, and it will continue to prosper, not by means of a hectic bonus, short-lived and demoralizing, but by the maintaining of a free market for gold, so that a man can buy or sell it at $20.67 per ounce at any mint in the United States. The oil industry of this country may benefit for a while from the protection of an import duty, but in the end the better sense of our people will compel Congress to rescind any such legislation, and it is more than likely to be succeeded by an export duty, levied for the plain purpose of conserving our oil resources. What is the sense of shutting the door to Mexican oil while ships are taking Californian oil to Australia? In the end humbug is futile. Everybody knows what Lincoln said about fooling the people; it stands true today.

Re-Location of Mining Claims

The Supreme Court of California recently held that the locator of a mining claim who has failed to perform the development work required by Federal statute may re-locate his claim immediately after the expiration of the assessment year and subsequently obtain title to the claim under the re-location. Mr. William E. Colby in the January number of the 'California Law Review' points out that an original locator who so desired could perpetuate his rights indefinitely by making a brief journey to his claim on July 1 of each year. As the law provides that the holder of a claim has the right to exclude adverse claimants even after 12 o'clock noon on July 1, if he is engaged in doing development work, it would be possible for him to start work during the morning of July 1, and, as soon after noon as no rivals were in the vicinity, to stop and re-locate the claim, which technically becomes open for location the instant that he discontinues active operations. The ruling of the Supreme Court of California makes such a procedure legal and valid; this interpretation permits him to abandon his former title in favor of himself, thereby taking advantage of his own dereliction. Among the reasons advanced by the Californian justices for their decision were two that may be mentioned. First, the Statute expressly provides that upon failure to perform the annual labor a mining claim "shall be open to re-location as if no location of the same had ever been made". They contend that no distinction should be made between the original locator and a second party. The question arises, however, whether immediate re-location after abandonment would not be void because of the improper or ulterior motive, that is, the intention of evading lawful assessment work without actually relinquishing any right. The Court's conclusion appears to be based partly upon the belief that the main purpose of the Statute requiring the performance of annual labor is to assure the leaving, to quote from the opinion, "of visible evidence of his claim for the information of other prospectors, to enable them to avoid taking up the same ground". This view certainly is open to serious question. Prospectors, mine-operators, and attorneys will agree that the main intent of the requirement for assessment work is to promote the development of the claim, by searching for and opening up ore, or by making needed preparations for mining operations; the building of roads or the digging of ditches to the claim may be considered as valid assessment work. This clearly refutes the statement that the main purpose of annual labor is to inform other prospectors that a particular area has been located. Regardless, however, of what weight this seemingly questionable interpretation of the Statute may have had in the reasoning of the Californian justices, the question must be answered: Can a claim-owner lawfully abandon one title and initiate a new one to the same property, for the purpose of evading the Statute? We are inclined to believe that few prospectors desire to take advantage of a technical point of this kind; but, if the Court's ruling is to be upheld, there is nothing to prevent a locator from continuing to hold his claim year after year in many States with virtually no work. In California a law was passed about ten years ago that prevented a claim-owner from re-locating his claim within a period of three years after the original location; in Montana the law inhibits re-location under any circumstances. Both of these Statutes seem to be open to reasonable criticism. The fact that a man has done his assessment work twice should not entitle him to hold a claim thereafter by virtue of repeated re-locations made with intent to avoid the performance of annual labor. On the other hand the Montana statute is too severe; the strict enforcement of it might easily work a serious hardship on the prospector. Mr. Colby has proposed that a fair law would provide that a period of one year from the time of the legal abandonment of a claim must elapse before it can be re-located by the former holder or holders. This interval would give any other prospector ample opportunity to stake the claim; if no second party thought well enough of the ground to re-locate, there should be no obstacle to the original claimant making a re-location, if he desired, at any time after expiration of the year. This is an excellent suggestion, not only for the State legislature of California but for those of other Western States. The decision recently made is subject to review by the Supreme Court of the United States, which must pass upon the point before it is settled finally.

DISCUSSION



Proposed Revision of the Mining Law

The Editor:

Sir—It is pretty generally agreed that our mining laws need to be revised, but the chief difficulty appears to lie in providing adequately for the wide range of existing conditions by means of one set of regulations. The old law, framed to suit the physical conditions of typical lode deposits, made no adequate provision for such deposits as were found later at Leadville and elsewhere, and therefore of necessity has been evaded or ignored in such cases. The proposed revision, in the evident desire to correct the inadequacy of the old law, and to promote the development of large-scale mining on such deposits as the porphyry coppers, has introduced changes less favorable to the development of lodes. The most objectionable of these, in my opinion, is the proposal to require the lines of a claim to conform to cardinal directions. It is manifestly impossible to cover the outcrop of a vein having a strike of any other than a cardinal direction and a dip any other than vertical, without including considerable territory, presumably worthless, back of the outcrop, and without limiting materially the area of the vein that will be included within the limits of the claim. If the locator is to be limited to that portion of the vein within the side- and end-lines continued vertically downward, he should be given the opportunity of covering the maximum-vein area possible within those lines.

The British Columbia method of delimitation would appear to be superior to the one proposed. In the mining code furnished to the Philippine Islands by Congress, in 1902, this method was followed, the apex feature being discarded and the size of a claim limited to 1000 ft. square. The maximum dimensions were reduced subsequently to 300 metres by the Philippine Commission, but otherwise the law has stood essentially as provided. Discovery is a prerequisite to location. Having made a discovery of mineral-bearing rock in place, the locator may then take as much or as little of the 300 metres in length either way along the outcrop, and as much or as little of the allowable width on one side or the other, if the ground is unoccupied. In laying out his claim, he establishes the No. 1 initial post either way along the outcrop within 300 m. of his discovery. This No. 1 initial post is the fixed point of the location. He then establishes the initial line, which passes through the point of discovery, as nearly as may be, by setting up the No. 2 initial post at 300 m. from the No. 1 post. The corner posts are established by measurements at right angles to the initial line from the initial posts. At any subsequent time he may amend his location by moving the No. 2 post outward or inward along the initial line, to correct errors in measurement or change his side-lines to cover unclaimed territory, within the limitations specified, but the No. 1 post must remain as first established. The application of this method of delimitation has proved satisfactory in practice, with a remarkable absence of litigation.

The proposed change requiring locations to conform to legal subdivisions, where such exist, is also objectionable, as applied to lodes in mountainous districts; because it not only imposes an additional burden on the locator, in determining the lines of such subdivisions, usually long since obliterated, but renders it even more difficult advantageously to cover outcropping lode deposits. I think that anyone who has had an experience of trying to find section-corners and lines in the West will readily agree with me in this.

Although the requirement of a bona-fide discovery of mineral in place as a prerequisite to location is closely allied in the old law to the extra-lateral right, it would not seem necessary to discard it with the abolishment of the apex feature, in the case of outcropping lodes, for with this class of deposit there is no good reason why a locator should not make such a discovery before taking up a claim. To abolish this feature will be to encourage indiscriminate location of territory in mineral-bearing areas, to the detriment of actual prospecting and development. There is no valid reason, however, why a 10-ft. hole should be required for this purpose, if mineral-bearing rock in place can be found at a less depth.

Regarding the performance of annual labor, while no doubt the aim of the old law is thereby to stimulate development work, as well as to make a reasonable expenditure per annum a condition for holding any part of the public domain, it has failed signally in both respects, for we all know that assessment work, as usually performed, is a farce. The actual work done is, as a rule, far short in actual value of the requirement; and seldom does it result in development of actual or permanent value. While the later provision, allowing work on one claim for the benefit of a group, has helped somewhat, the annual expenditure for assessment work in this country represents a very considerable waste of money and effort, merely for the purpose of complying with the law. A remedy for this condition is not in sight. The proposed revision does not accomplish it, though the provision for a cash payment in lieu of labor, while not stimulating development, may stop some of the present waste. It would probably result in more territory being held unproductive than at present, by making it easier for a non-resident to pay the tax instead of paying a prospector for doing the required work. Incidentally it may be remarked that probably much of the opposition to the proposed revision on the part of the prospector, arises from the anticipated effects of the provision mentioned, in cutting off a common source of revenue for him, for it is well known that many prospectors depend for their principal cash income on the performance of assessment work for non-resident owners.

The best suggestion I recall for remedying the assessment evil was made by E. B. Kirby before a meeting of the American Mining Congress. He proposed to substitute for the supposed performance of $100 worth of work, the payment into a local treasury of half that amount per claim, to be used in building and maintaining roads and trails in the district in which the claim is located. This would tend to stimulate development of each district as a whole, and it could be made less of a hardship for the prospector or claim-owner, by allowing him to contribute labor at the prevailing rate of wages for the district, in lieu of cash.

If the old law as applying to lodes could be amended to the extent of abolishment of extra-lateral rights, the adoption of a method of delimitation similar to the one described, but with a limit of 1500 ft. square, and the substitution of a definite footage of development work each year for the prescribed expenditure of one hundred dollars, it seems to me that it would better fit the conditions surrounding the exploration of this class of deposits. The massive, flat-lying, and non-outcropping deposits might be put under a separate classification, by enacting regulations similar to those proposed. The old law recognizes the distinction between lodes and placers, and provides for them in distinctly different ways. Why cannot a new code go further and provide for a third class along the lines of the proposed revision?

San Francisco, February 17. C. M. EYE.

Wetting and Amalgamation

The Editor:

Sir—Mr. Mason accuses me of attempting to be facetious in my letter that was published in your issue of December 31, and I hasten to deny the impeachment, at least as far as intention goes, for I certainly did not intend to be facetious. However, some people are most humorous when they are deadly serious, and I may have unwittingly fallen into that class.

Mr. Mason fairly floors me with the poem of Eden Philpotts with which he concludes his letter. I have read it several times without being able either to determine what bearing it has on the matter or what it means in itself. Next, I consulted several engineers (without fee, however) and the consensus of opinion is that Mr. Mason believes I regard him as a mud-puddle, to be stepped in with impunity. Again, I must protest that Mr. Mason does me an injustice, for any such concept is as remote as possible from my mind. But, of course, if it were true, his irritation would be as justified as that of Miss Pleasant Riderhood in 'Our Mutual Friend'. You remember she was engaged to be married to Mr. Venus, the expert articulator of skeletons, but abruptly broke the engagement on coming to believe her fiancé looked upon her as a possible future subject for his professional skill; exclaiming, with justifiable resentment, that she did not "regard nor wish to be regarded in that bony light".

Mr. Mason somewhat beclouds the issue in several particulars. He says that if he had only been fortunate enough to have read my paper (which appeared several years later) he need not have made the experiments he described. The real point is that if he had read the papers which had appeared previous to his making the experiments described, he need not have made them, either. If there is any obscurity in my previous language, let me now say distinctly that there is nothing in Mr. Mason's letter of December 3 to indicate the work that he did was more precise, more extensive than, or directed toward clearing up any points of doubt in, the previously published work. Mr. Mason also says, as regards publication, that the "result of the experiment was embodied in a paper on gold solvents that I read before the Mining Society of Nova Scotia, and which duly appeared in its transactions". The reader would inevitably regard this as an indirect statement that the results of the experiment were published, but in the only paper by Mr. Mason on gold solvents that appears in the Journal of Nova Scotia Mining Society (Vol. II, p. 152) the solubility of gold in mercury is not even mentioned, so I fear he has dragged a red herring across the trail of argument.

Certainly this is true of his citation of Rayleigh's work on nitrogen, as a case in point. If I may couple myself with Mr. Carnegie, I am sure neither of us had any objection to work that is intended as a more precise determination of physical or chemical data, or the clearing up of obscure points. The economic waste arises when work is repeated without doing it more accurately. According to his own description of it, Mr. Mason's experiments on the solubility of gold in mercury were not performed with as much care, or on as extensive a scale, as the work that Dudley had published in full detail in 1889.

All this, however, brings me to a point I would like to stress briefly, namely, the waste that occurs through unnecessary talking and writing. Nearly everybody is an offender in this regard. On our way to work in the morning, we meet a friend and we start discussing the weather with him. Now, none of us ever attempts to do anything about the weather, and consequently discussion of it is only a waste of time. And all of us keep talking about things that interest us, although we have adequately expressed our ideas on the subject before. A good case in point is the editorial on the risks of mining, which appears in the same issue with the letter from Mr. Mason. I should roughly estimate that the editor has already written enough to make several large octavo volumes on the risks of mining and in these volumes everything of significance in the editorial will be found occurring not once, but several times. Of course, I know the old story of the Scotsman who said to his wife, "Jeanie, why do you keep telling that child the same thing?" And Jeanie replied: "because telling him once is not enough, Jock". But the people who read the 'Mining and Scientific Press' are fairly well aware of the risks of mining; some of them are acutely conscious of them at the present time. The people who most need to be told more than once of the risks of mining do not read the 'Mining and Scientific Press', unfortunately for them, and are as blissfully unconscious of the repetition as of the first statement.

THOMAS T. READ.

Washington, February 11.

Russian Placer Mining

The Editor:

Sir—Mr. Leon Perret remarks in your issue of December 16 that my observations published on May 14 set him in a state of perplexity. Apparently elaboration is required on some points.

Seven years ago in 1915 the Second All Russian Congress of Gold and Platinum miners stated that they required about 200 dredges, and as a result of this and other formulated requirements to stimulate the gold and platinum production, a law was passed having the effect of removing the duty on dredges, and loans were made by the State Bank at 5% to the extent of two-thirds and in some instances three-quarters of the money required to purchase, transport, and erect dredges or other approved equipment for meritorious properties. I know that a number of parties took advantage of these provisions. There was little difficulty involved. The Governmental District Engineer passed on the application from familiarity with the property, or examination into the circumstances and merits of the property, as to whether it might advantageously employ machinery such as dredges or other excavating plant. Thus was presented the opportunity of opening the vicious circle of hand-to-mouth policy, even in the case of individual undertakings or partnerships.

With reference to the transportation of the 17-ft. dredge to the mines at Bodaibo, purchased by the Lenskoie company, I think that this matter came up for final consideration after Mr. Perret left Bodaibo. It has received careful consideration from the two subsequent managers and their advisers. Connected with the question of design of dredge suitable for the depth of ground and dredging conditions, there was the question of transporting such a machine to the point of erection at Bodaibo, far north of Irkutsk. I am in a position to know what the program was then and is now. Naturally conditions have changed somewhat from time to time as regards transportation.

During the Kolchak regime it was thought possible at one time to transport the dredge to Bodaibo. The least practicable route is by the mouth of the Lena river, if for no other reason than the time taken and the doubts as to whether the shipment would arrive at all. Preference was given at that time to the idea of loading the machinery on cars at Vladivostok direct to Irkutsk by rail, rather than the Nicolaievsk and Amoor river route to Irkutsk, saving time and frequent unloading and transferring. From Irkutsk the machinery would be taken by tractor-trains to a point on the Lena river considered most suitable at the moment, having regard to the season for navigation on the Lena, thence in barges and steamer to Bodaibo, thence by rail to the point of erection.

In 1916 a road was started at the joint expense of the Government and the Lenskoie company to take care of the transportation problem for the Lena district. This road starts near Bratsk on the Angara river and is projected to Ust Kut, a point on the Lena river beyond shallow water and navigable during the whole season to Bodaibo and other points down-stream. The road will be suitable for heavy traffic such as the tractor-trains now in Vladivostok, and bridges will be built accordingly. The maximum grade is 8%, with width and curves suitable for the traffic and the machinery in question. When the machinery is started on its journey, should this road be ready, it will be transferred direct to barges at Irkutsk, moved to Bratsk on the Angara, loaded onto tractor-trains for Ust Kut, thence by steel barges of 1600 tons capacity, of which there are four belonging to the Lenskoie company, direct to Bodaibo and by rail to the point of erection. There are four tractors of 75 hp. with wagons complete at Vladivostok for the purpose, and cranes for Bratsk and Ust Kut. The electric crane at Bodaibo is in place now. The transportation problem seems pretty well taken care of, and even if the machinery should be taken direct to the Lena owing to the road being unfinished from Bratsk to Ust Kut, the expense of strengthening the bridges and repairing the road to make it suitable for the passage of the machinery would not be great in comparison to the whole project.

Electric power is available at the mines and can be increased as required for future dredges. With regard to the operating conditions at Bodaibo, the long heavy bucket-line of 3½-ton buckets reaching about 80 ft. below water-level when in motion will have considerable effect on the bedrock, sufficient to take care of most of the gold there. There is an additional objection to digging downstream: when breaking into fresh underground workings with a lower water-level, some inconvenience might be experienced in the rapid lowering of the level of the water in the pond.

Some of the richest parts of the pay-streak under the Bodaibo creek were not worked owing to the excessive water. There is also the ground between bedrock workings and the surface which will add materially to the yield. Further it is expected that nuggets and fine gold will be recovered by the company. The flooding of the ground will make it impossible for unauthorized persons to get to the rich ground, also a matter of importance. A third of the ground has been reported as frozen. The major problems at the Lena have been met, and experience gained in other parts of the world is being utilized. Cold-water thawing may help considerably. Dredging has been carried on at Dawson at a lower temperature than prevails generally at Bodaibo during the coldest months. The Natomas company has worse bedrock conditions.

The part where the first dredge was to start is the Andreevsky and Bodaibinsky sections, the lower part of the Bodaibo placers. These hand-workings gave roughly \$5 to \$6 per cubic yard of pay-streak worked. It was shut-down because it did not yield enough to meet expenses. It could not have given the same normal profit as the other places. The Feodorisivsky yielded \$14 to \$16 per yard of ground worked.

The cost has been considered and the proposition was deemed to be good business, with an excellent chance of getting dividends, a matter that frequently seems to be overlooked. Many so-called difficulties were met at Nicolo Pavda but they were all in the day's work. After the experience of getting and operating a dredge much heavier than usual in that district the management promptly bought two more, without hesitation.

It is only necessary to observe carefully the conditions and make suitable and adequate preparations to meet them. It is not necessary to go as far as Bodaibo to fail if these precautions are neglected.

With reference to Nicolo Pavda, Mr. I. A. Losieff ordered the steam-dredge from the Putiloff works before the prospecting was done, without reference to the results. It should have been an electrically driven dredge. Some alterations were necessary, and these were effected before it was erected. The dredge was accepted with hesitation, as before mentioned. When the price of platinum went up at Petrograd to as much as 25 times the price before the War, two more steam-dredges were erected, making three steam and one electrically driven dredges, and two more electrically driven dredges were ordered in America, and the steel hulls for these were begun at the point of erection. The machinery got at least to Vladivostok. It could be delivered by rail to within about 50 miles of the point of erection and taken by teams over the snow roads. As many as 50 horses were used sometimes on one piece, on a special sleigh provided by the contractors. Many of the loads arrived in two, four, and six-horse teams, or as many horses as would be required. The trip took about three or four days. A sleigh for the heavier machinery required to be specially built, but many of these were in the possession of the contractors. One would cost at that time about 75 rubles—not much in our money!

The dividends of the Nicolo Pavda company of 8,000,000 rubles was paid as usual in Russian rubles, neither gold nor platinum. It unfortunately happened that railroad transportation was not good enough to keep up the output of other industries such as the saw-mills and the paper factory, in 1917, as most people know, whereas the monthly output of platinum could be transported personally.

There is some mention of the exaggerated importance of Nicolo Pavda, which I prospected when I had charge of the installation of dredges. There is no exaggeration in my statements, for the value of the ground, 32c. per cubic yard for 26,000,000 yards, is about half the present value. It does not include much ground that came into the producing class on the increased price of platinum or the ground where two of the steam-dredges were erected. Nor is it unimportant with four dredges on the spot and two on the way, with room for more. They cleaned up nicely when prices were highest, which, as someone mentioned, is good business.

It was my good fortune while in Russia to come in contact with a number of Russian engineers, among whom there were many of good judgment, great ability, and much common-sense. The better one gets acquainted the more these facts stand out. They have been working along lines imposed by their environment. There have been great changes in Russia and I am quite satisfied that the engineers will adopt methods most suited to their particular local problems, drawing if need be from experience under similar conditions in other parts of the world and thereby bringing a measure of prosperity to that unhappy country.

R. S. Botsford.

New York, February 1.

Platinum

The Editor:

Sir—I have been much interested recently in your articles relative to platinum, including those involving the determinations made by Mr. L. E. Sowers, of Winnemucca, Nevada. In this connection I have a clipping from some paper, which reads as follows:

"A California chemist recently made a discovery that will be of value to gold-miners everywhere. He found that in testing ore for gold with a supplementary process, platinum was also extracted. The hope is now that a great deal of gold and silver ore may also yield platinum, which is more valuable than either of these other precious metals. One company is already clearing an additional \$2400 a ton from the platinum secured in this way."

I write to inquire if you have any available information relative to the subject-matter of the clipping?

Tacoma, February 20. H. O. Watrous.

[The newspaper statement contains the minimum of truth, as usual in matters of this kind. It is true that the recovery of platinum as a by-product in gold-dredging is a comparatively recent development in technical practice and that, for example, the Californian dredges yielded 667 ounces of platinum in 1920, but it is not true that a great deal of gold and silver "ore" is likely to yield platinum, if by "ore" is meant rock in place that can be exploited at a profit. Platinum has never been won in California from ore in place, only from gravel. The statement that ore yielding \$2400 per ton in platinum is being mined anywhere in California is without basis of fact, so far as we know.—Editor.]

Early Comstock Days

By Roswell K. Colcord

In dealing with Nevada's early history, the Comstock mines and Virginia City must be considered first for probably never before has so much wealth been won from so small a piece of ground. The space is about two miles long and the width that of an ordinary street. The record shows that the Consolidated Virginia, only one of the many corporations, yielded $62,570,154 in gold and $70,901,517 in silver; a total of $133,471,672 up to 1907. These figures are authentic. The estimated output of all the Comstock mines from 1860 to 1900 is $500,000,000.

The first to come to a new mining camp is the prospector, next the miner, followed by the saloon-man and gambler. Then come the business-man, the lawyer, and the doctor, and by the time the preacher gets there he has an abundance of raw material for the manufacture of Christians. If he is a good sport and a mixer, energetic and persevering, he will soon build up a business that will prove profitable to the entire community: schools will be established, society will organize, social functions will be held, the moral machinery will soon be running smoothly, and law and order will be paramount.

There is always a larger number of law-abiding people in any community, young or old, than of the other kind; this was especially true of Virginia City during its first ten years of life. The rough element was there in force, but the good men of the town were not cowards like the ordinary gun-fighter who is easily crushed by a brave and determined man, without a gun; consequently, the unruly class was kept well in check by moral force. I may say here that much credit is due the better men among the gamblers for their aid in preserving the peace. Joe Stewart, proprietor of the largest sporting establishment in the town, was one of the solid men of the place; his word was accepted everywhere and his paper was honored at the bank for any reasonable amount. Thousands of dollars were won and lost at his tables every day, yet the place was always orderly. Another honorable sport was Kentuck (John M. Daniels). Both he and Stewart were gentlemen in their class—tall, slim, straight, good-looking, and always well-dressed; in fact the best-dressed men in the town were the sporting fraternity. When it came to contributing to the church, or to any charity or public enterprise, they were the first to the bat.

Although Virginia City had a hard reputation, I know from personal experience that it was as orderly as a Quaker meeting in comparison with either Bodie in the early 'eighties or Aurora in the early 'sixties, for I lived during the roughest times in all these places. We all know that environment has a strong influence, and that we do things in the Far West that would 'put us in bad' with the people of New England; possibly the life I was then living may have had some influence in modifying my own viewpoint, yet I still insist that we of Virginia City and Gold Hill were good people—for the frontier. Indeed, the first settlers of Virginia City were above the average in intelligence, culture, and ability. Real poverty did not exist in the town; money was plentiful, and in cases of death, sickness, or distress, the generosity of the people was boundless.

The chief occupation was watching the stock-market. One share of stock then represented one foot of ground. When our party, consisting of Horace Marden, George Peck, Charles Cunningham, Ben Severence, and myself, arrived there, the combined capital would not buy one-fourth of an inch of ground in any of the leading mines. Even I, though never a member, was vestryman of a church. We had a wonderfully interesting minister; but, not being a Puritan, he started out on Christmas night with a bunch of Cornish boys to sing carols, and failed in his efforts to absorb an amount of moisture equal to that taken by the other boys. When they took him home he was unable to speak his language intelligently, although a fine linguist, but he insisted on talking Spanish. This was too much for the church people; so we lost our pastor, much to my regret, for he was a fine fellow, and a finished scholar and orator. He had been an actor.

Mining stocks were the chief attraction for all, except during political campaigns; then all other business was neglected. In 1868 the big local fight was for sheriff of Storey county, Jewett Adams (afterward Governor) was the Democratic candidate, and W. I. Cummins, president of the Gold Hill Miner's Union, was the Republican candidate. The Gold Hill Union was the first organization of the kind in the State, and for many years was the best-managed and the most conservative of any subsequent organization on the Comstock or elsewhere. It was a bitter fight, for Adams and his friends had plenty of money and used it freely, but neither money nor oratory could out-vote the miners, and Cummins won an easy victory.

During the winter of 1867 there were so many serious cases of smallpox that the authorities had great difficulty in giving them proper care, as it was impossible to procure nurses at any price. Deaths occurred almost daily. At that time I was superintending the erection of a large building for hoisting-works and pumping-plant, and sinking a five-compartment shaft to a depth of 1000 ft. for the Imperial Empire Co. A number of our crew were victims of the disease, and there were four deaths. One morning as I was examining a set of timbers in the bottom of the shaft, I noticed one of the men leaning against the wall and holding his head with both hands. The shift-boss, John Milligan (father of Miss Milligan of Carson) asked the man if he was hurt, and he said he was dizzy. On closer view, Milligan said his face had broken out in a rash. We took him to the surface at once and he was so weak that Milligan picked him up in his arms and carried him to the engine-room and wrapped him in a blanket. He was put into my buggy, and I drove him to the pest-house. That was a real act of heroism on the part of Milligan, for he knew it was a case of malignant smallpox. I was not much exposed, and besides I was using Dr. Webber's remedy, or rather preventive. The Doctor's prescription read: "Keep an unlighted cigar in your mouth all the time you are near people who have the disease or who have been exposed". John and I both escaped.

The most serious disaster, causing the greatest loss of life that ever occurred on the Comstock, was the underground fire at the Yellow Jacket mine in 1868, where more than 60 men were asphyxiated, 23 losing their lives. It required strong nerve to stand by that shaft and see those poor fellows, with swollen faces, eyes nearly closed, and gasping for breath, brought up on the cage. At that time gas-masks were not known among the miners, but real bravery was plentiful, and many were the volunteers to go down on the cage and try to rescue comrades. A number of trips were made and several times those who had gone to the rescue were themselves brought up unconscious. The two Bickel brothers, whom I knew intimately, were working there. George was among the first to come up, but finding that his brother was still in the mine, he insisted on going back with the rescue-crew. He succeeded in finding his brother and in bringing him up in his arms; on reaching the surface both collapsed. The doctor did everything possible to revive them, but they died almost in each other's arms.

Jim Langan (father of Judge Langan) was foreman of the mine and did heroic work in directing the rescue. It required skill and judgment on the part of the engineers and brakemen in handling the cages. One of the brakemen was W. H. Stone, who was Justice of the Peace in Carson City for many years.

Gold Hill was as lively as Virginia City. Our club, called the Boar's Nest, was one of the jolliest in the town, considering the extent of its membership—only fifteen young men. It was organized for 'eats'. We rented a house, hired a cook, and started housekeeping. The cook was an Italian gentleman and an expert. We lived high, and the monthly bills were higher. We soon learned that the cook and his friends also lived high at our expense, but we were having such a jolly time that we kept it up for several months. Among the crowd one individual was tinctured with piety, although equally good at giving and taking jokes. He requested permission to ask a blessing on Sunday morning, as usually we breakfasted together. We agreed unanimously. During the blessing, which was lengthy because he had to bless the food for a whole week in advance, the cook served the coffee. One Sunday morning we were gathered together around the table and our friend (his name was Bostwick) started his blessing. When his eyes were closed as was his custom, the cook filled his cup. Lou Goodwin, who sat next to him, picked up half a dozen chili capinis and dropped them in the coffee. We all saw the act and of course paid strict attention to breakfast for a few minutes until 'Old Bos' as we called him, took a good swig of reinforced hot coffee. He made every effort to check strangulation but could not prevent the tears from running down among his whiskers. Finally some one asked him if his coffee was too strong, and further remarked that he looked as if he were in trouble. Bos replied in a solemn manner that he had just received a telegram saying that his mother-in-law was dangerously ill; the fear that the next message would tell that she was not going to die caused the tears.

The Fourth of July was always celebrated by a joint procession of residents in the two towns; it was a big affair. In 1866 Colonel (afterward Governor) C. C. Stevenson was Grand Marshal. Six of us were aids on his staff. Virginia City being on a steep side-hill, it was necessary to have narrow streets to avoid grading; as it was, a one-story building fronting on C street would be two stories at the back. The board sidewalks were frail, and when Harrison Gray, one of the aids who rode a fractious horse, was marching down C street, his horse pranced onto the sidewalk, and horse and rider went down entirely out of sight, but they kept right on, came out on D street, went round the block and joined the parade all O.K., except for a few yards of cobwebs on horse and rider.

C street was not a nice place for promenading in the winter and early spring. All the ore was transported on wagons drawn by big teams that splashed in the mud the entire length of the street, spattering it on both sidewalks. As everybody, except the sports, were dressed to wallow in mud if necessary, they did not shy at it. The reduction-works then were on the Carson river and at Ophir in the Washoe valley; the teams hauled ore and returned with wood and lumber. No water for milling purposes was nearer at that date.

So many men and women of note were living on the Comstock that it would be difficult to judge as to who are the most deserving of mention. J. C. Hampton was the leading grocer; Harry Rosner, the leader in dry-goods; Kennedy and Mallon, wholesale liquor; Charley Van Gorder, team-owner; William M. Stewart was the most industrious and successful lawyer; Tom Fitch, the most eloquent public speaker; Gillig, Mott & Co. were the leading hardware merchants; Reverend (later Bishop) Whittaker and Father Manogue, the leading clergymen; Adolf Sutro the most able, determined, and successful promoter, especially in the matter of raising money in Europe and elsewhere for the driving of the Sutro Tunnel for draining the Comstock mines to a depth of 1600 ft. This tunnel is nearly five miles long and big enough for a mule-team. Later Sutro was elected mayor of San Francisco, notwithstanding the opposition of every newspaper in that city.

The most disastrous financial failure on the Comstock was that of L. B. Frankel. The most approachable and the most generous man of great wealth was John W. Mackay. Practically all his wealth came later, but it did not change the man. It is a well-known fact that the Big Four—Mackay, Fair, Flood, and O'Brien—accumulated many million dollars in Nevada, took it away and invested it elsewhere, and did nothing for the State; yet John W. Mackay while a resident was a liberal contributor to charities, and without ostentation. Many poor families received substantial aid at his hands without knowing who their benefactor was. After his death his son, Clarence, contributed largely to the upbuilding and beautifying of our State University. William Sharon, who made millions on the Comstock, gave us the State Orphan's Home.

Those who have read Mark Twain's 'Roughing It' will remember the author's description of the hold-up on the divide between Virginia City and Gold Hill. This was true, and the perpetrators of that robbery were Twain's most intimate friends. It took place within a block of the house where I lived. George Birdsall and Col. Avery were the leaders. When Mark left on the stage the next morning they gave him his money and valuables, but he refused to be consoled and, saying "Farewell, brigands", left without sign of forgiveness. This incident occurred during Twain's lecturing tour on the subject of the Sandwich Islands.

Among the startling incidents on the Comstock in the early 'sixties was the sinking of the Wood & Goe store. This store stood at the junction of B and C streets on the divide between Virginia City and Gold Hill. The Chollar Mining Co. had stoped the ground so near the surface that it began to settle and crack, although this attracted but little attention. One night a number of us went up from Gold Hill to the theatre at Piper's Opera House. On our way home we picked up a young fellow who said he was a clerk in Wood & Goe's store, and slept there. You may imagine his feelings when we reached the place where the store had stood and found a cave fully 70 ft. across and 30 ft. deep. The surface had caved around the rim, completely covering the building. Not a sign of it was to be seen. That young man's nerves were pretty badly shattered when he realized his escape from a horrible death. He said he had been learning to dance in a hurdy-gurdy house that evening, and added that if that was sinful, he preferred to be a sinner rather than a corpse.

As a lover of horses from childhood, to witness the abuse of that noble animal makes me ready to fight. Many years ago, while visiting Carson City, a prominent gentleman invited me to take a drive with him behind his fast horse. While going around to get into the buggy, I discovered a deep flesh wound on the horse's rump. Upon inquiring how the horse was so badly cut and also why the owner was driving him in that condition, he said that he did it with a singletree and the iron hook did the cutting. I not only declined to go with him but made use of some language learned in my youth from a mule-driver.

What to me was the most serious and horrible mutilation of dumb animals occurred in 1866 just above Gold Hill. One of the big six-horse teams loaded with probably 10 tons of ore on two wagons was driven down to the Kennedy boarding-house across the road from the Bullion hoisting-works; while the driver was at lunch the brake became loose, and being on a down grade the wagons started, pushing the wheel-horses and finally the whole team down the road. By the time they came to the turn above the Belcher hoisting-works they were traveling fast and in making the curve, both wagons left the grade and rolled over and over down the steep hill, dragging those six big and beautiful horses with them. Porter Holmes and I witnessed the end of the runaway, and were the first to reach and lend aid to those struggling, dumb, though groaning animals. All were endeavoring to clear themselves from the harness, and every horse was cut and bruised. The wheel-horses were held down partly by the wagon-tongue, and both were trying to get up. One had both forelegs broken, and to see those animals trying to walk with the stumps of their legs, the bones sticking in the ground was sickening. Within a few minutes several men arrived, one of whom brought his gun, and we immediately shot the two horses with the broken legs. The owner of that team told me that those horses were worth $500 each.

Most of the mining superintendents drove fine teams. Bob Graves of the Empire, with his spanking team and $1200 diamond scarf-pin, was the most showy superintendent; Captain Thos. G. Taylor of the Yellow Jacket, the most genial; Isaac L. Requa of the Chollar, the most industrious; P. S. Buckminster of the Imperial, the most dignified; James G. Fair of the Con. Virginia, the best miner; Sam Curtis of the Ophir, the oldest, biggest, and ugliest; Hank Smith of the Belcher, the best talker; Fred Tritle of the Alpha, the handsomest.

The Gould & Curry stock was the first to reach a high figure on the stock-board. Charley Bonner was superintendent, followed shortly afterward by Frank Osbiston, a typical cockney, who soon became the most popular man in town. He was tall, six feet three, young, straight, a graduate of Oxford, and well up on mining booklore, and a great favorite socially. He soon learned to be a successful mine manager. In those days few of the superintendents knew much about mines or mining, but most of them were good business men and knew how to select their subordinates.

Abe Edgington was the chief millman and general manager of all the plants belonging to the Sharon interests. John B. Winters was the first superintendent of the Yellow Jacket; L. B. Hopkins of the Kentuck was the biggest and wore the longest whiskers; J. P. Jones of the Crown Point was the best story-teller; Charlie Forman of the Caledonia and the Forman shaft was always a busy man, but was handicapped socially by being too fond of himself; Ed. Boyle of the Alta (father of our present Governor) loved everybody and feared nobody—always at the front in business, politics, or fun. Mat. Canovan distinguished himself by giving a ball and banquet on the 1000-ft. level of the New York mine. He cut out a big station, decorated it with Chinese lanterns, and invited thirty couples. It was a great free treat. This, however, did not occur in the pioneer days, for Canovan came to the Comstock later.

In the Nevada field of literature there were many brilliant men and women, but only one was entitled to the distinction of being the most accomplished liar—Jim Townsend. Virginia City was the special attraction for all leading theatrical people who came to the Coast from the East. James Stark and his wife, both stars, were among the first; they were followed by scores of others whose names are familiar to old-timers, but to enumerate them would require too much space.

Included in the greatest attractions among theatrical folk was Little Lotta (Miss Lottie Crabtree). Her special forte was singing and dancing. Her song, 'Washoe', composed by herself, created such enthusiasm with all classes that showers of coin took the place of bouquets, and many were of gold. Lotta was a born lady and remained so all her life. She played in all the big cities of the world and her mother was always with her. Lotta's fountain at the junction of Market, Kearny, and Geary streets in San Francisco was her contribution to this city. She retired with a fortune of about $400,000, invested it in real estate near Boston, where she still lives at the age of about seventy-five, and unmarried.

The other extreme was Ada Isaac Menkin, who held the boards for quite a time in 'Mazeppa'. She dashed across the stage lashed lengthwise on a wild horse, and dressed in the costume of Eve. This created wild enthusiasm, and one did not have to be bald-headed to enjoy the scene. Later we had John McCullough, Lawrence Barrett, and others equally famous.

All of these men whose names appear in this paper as being more or less prominently identified with the development of the great Comstock lode more than half a century ago were friends and acquaintances; their voices and faces are so indelibly stamped on my memory that the recalling of their names necessarily causes a feeling of sadness and loneliness when I realize that not one of them is living today.

Size of Mineral Particles in Relation to Flotation Concentration

*The size of the mineral particle is a factor of flotation that has been given little more than a passing thought by flotation engineers. Every one familiar with the older gravity methods of concentration well understands the advantages accruing from close classification of the feed to the concentrators. However, it is not logical to assume that classification of feed for flotation will be equally profitable. The following analysis of the subject should be of value.

The factors controlling the size of a mineral particle that can be floated are: (1) the degrees of oil-mineral, oil-water, and air-water adsorption, which determine the force with which the particle is held to the bubble; (2) the shape of the particle; (3) its specific gravity; (4) the cleanness of its surface, which influences the degrees of adsorption; and (5) the swirl of the pulp.

Maximum flotation efficiency is obtained by treating the largest particle that can be floated by its first attachment to a bubble or a number of bubbles. When the mineral particle is of such size that it is dropped and caught many times by the rising bubbles before it is entangled in the froth and finally removed from the machine, finer grinding would result in greater recovery and higher efficiency.

It is obvious that the agitation and swirl of pulp, particularly near the surface, will influence greatly the size of particle floatable under given conditions. A machine giving a concurrent motion to the pulp will allow a mineral particle of maximum size to be floated. The size of bubble is important; the more numerous and the finer the bubbles, the more efficient will be the flotation. There is no doubt that a good many bubbles actually engage each particle before it is finally floated to the surface of the pulp.

Conclusions reached are as follows: (1) For the flotation of a single sulphide mineral away from gangue, it appears that classification either as to size of particle (screening) or as to size and weight (hydraulic classification) would be of little value, excepting that it would give a more uniform condition of total mineral surface which could be more consistently met in practice; (2) of two particles of the same mineral, the smaller has the greater total flotative intensity; (3) with two particles of different minerals the widest difference in total flotative-intensity would result if the particle of the lighter mineral were the smaller and had the higher unit flotative-intensity, because the difference in the weight of the two particles is then greatest, and the specific surface increases as the size of the particle decreases; this association of particles cannot be realized by classification; (4) for two different minerals the conditions of three cases studied could be obtained by water classification. If the smaller mineral happened to have the higher unit flotative-intensity, water classification would make the separation of the two minerals by flotation more readily accomplished.

For two floatable minerals of equal or nearly equal specific gravities, water-classification would give a product more adaptable to differential flotation than if two minerals were composed of material of widely different specific gravities.

To elucidate: water-classification of particles of unlike specific gravities would give products consisting of large-light and small-heavy particles. The small-heavy minerals would have greater specific-surface, and consequently greater total flotative-intensity, which would, however, be largely counterbalanced by the greater weight of the small particles.

It is possible to apply the same reasoning to show why a feed of small-light and large-heavy particles would give the greatest difference in total flotative-intensity of particles, and the most advantageous relation of particles for differential flotation.

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*Abstracted from a paper by A. W. Fahrenwald and issued by the Bureau of Mines and Geology, State of Idaho.

Work and Industrial Progress

By A. W. Allen

No apology should be needed for broaching in a technical magazine the subject of individual human effort and its relation to industrial progress, for it is one of paramount importance. A change of mental attitude is taking place slowly but surely; human effort is being recognized more generally as the fundamental basis for successful achievement; and human effort means work. A few years ago I was in a country that is exceedingly backward—mentally, morally, and physically. I wondered at the persistence of the national traits through many centuries, and found that the question had been asked and answered a hundred years before. In a book published in 1825 a traveler recorded the main impression of a visit there, by stating that "human industry and ingenuity are destroyed by the belief that a confidence in a supernatural power is of more effect in assuring the progress of nature, or in averting the evils and miseries attendant upon our earthly career, than a more rational and manly reliance upon our own muscular and mental exertions over the elements of the material world that have been placed under our control". A story may be recalled of the Scotch boatman whose craft met a sudden squall and was on the point of being capsized. Amid the roar of the elements he overheard a decision made by his two passengers—who differed widely as to build and physical characteristics—that they should pray for better weather. The boatman, however, agreed to this proposal only in part. "The little mon can pray", he said, "but the big one maun tak' an oar." He considered that a combination of the spiritual and the practical was needed, to the disregard of neither.

Superstition has been one of the most serious stumbling-blocks to progress, but during recent years much of this has been replaced by a recognition of the value of the achievement that follows initiative and labor. In these days of intensive competition it is realized more than ever that increased production and continuous output are essential. Idleness and the misapplication of energy mean waste, and there is an appalling amount of these in evidence in industrial as well as in individual effort. Herbert Hoover, in a foreword to a report issued recently by the Federated Engineering Societies, says that as a nation we possess what is probably the maximum of ingenuity per capita; our industries operate at what is doubtless the highest efficiency as compared with those of other nations; yet our industrial machine is far from perfect. An enormous amount of waste is occurring daily in consequence of (1) unemployment during industrial depressions, (2) Labor-Capital conflicts, (3) excessive labor-turnover, (4) speculation and over-production in prosperous times, (5) a lack of standardization, (6) the occasional failure of transportation, and (7) losses during fabrication. These wastes when aggregated represent reduction in quality and service, both of which could be improved proportionately by a greater attention to detail. However, I do not propose to discuss corporate effort, but will confine what I have to say to the attitude of the individual and of those who are or who should be interested in his welfare and progress. In the first place, it is imperative that the worker be encouraged at the outset to select an occupation that appeals to him and that suits his mental and physical capabilities and characteristics. He, on the other hand, should leave no stone unturned in his effort to find work that is congenial; for, in the great majority of cases, such choice is not the result of chance, nor does it follow inevitably a policy dictated by others; the individual himself must show initiative and preference; the blame of failure on this account rests with him alone should he fail to do so.

One phase of human endeavor is known as unskilled or manual labor. A philosopher once said that there is no task, not even the digging of a ditch, but has interest and romance in it if the work be done in the right spirit. A contention such as this is likely to be misinterpreted; for the facts should be faced, and it must be acknowledged that some work is uninspiring and monotonous, not to say nauseating or revolting. However, let us desist from an attempt to gauge the mental attitude adopted by another toward the particular task being performed by him; if we do so we are likely to indulge in sympathy that will be wasted. The worker's viewpoint in this connection is largely a matter of familiarity; a skilled dentist may see nothing unpleasant in professional work that would sicken an artist; a miner who is skilled with hammer and drill needs no sympathy from the bystander who cannot see further than the monotony of the labor involved; the millman thinks nothing of the clangor of a thousand stamps, whereas the nerves of a visitor may be racked to a degree that may presage physical collapse. It is a futile interference and a waste of compassion to commiserate with others on account of tasks with which we have no intimate experience. If dissatisfaction be expressed by the worker it may be due to conditions over which no one has control; it may be because the task is unsuitable; it may be because the work is such that too much time is available for self-commiseration; or it may be because the worker does not handle the job in the proper manner. Perhaps he is disheartened at the results, and so takes no steps to increase his efficiency.

One of the most interesting results of the safety-first movement showed that it was possible to differentiate workers into two types—those with whom accidents were common and those with whom they were rare. The more unfortunate worker or shift-boss was inclined to consider that they were due to causes over which he and no one else had control; and in this connection it is interesting to note that no saying has wrought greater harm to humanity than the one that insists that 'accidents will happen', for it is used too often to cover the tracks of a neglect to take precautions. The dictionary tells us that 'to happen' is 'to occur by chance'; chance is something that befalls in consequence of unknown or unconsidered forces; an accident is an event that is unexpected and is usually of an unfortunate nature. Thanks to rational intervention, the psychology of accidents is now viewed from an entirely different standpoint. The element of chance is no longer feared, for it has been found that almost all accidents could have been prevented by the exercise of proper care and adequate foresight.

An intensive campaign of education, unhampered by superstition, has given remarkable results. Available statistics prove conclusively that workers or bosses who sought formerly to excuse their unfortunate showings are now proud of a record that often indicates a complete immunity from even a minor mishap. This is largely the result of unsconcious weaning from superstitious ideas in regard to chance; it shows that the unconsidered rather than the unknown forces should receive primary consideration; for, thanks to contemporary science, the unknown forces are becoming fewer and fewer. The result is an education—it might be called a religion—of actualities, and the realization that personal effort is not likely to be balked by the machinations of some unseen power. Failure that is blamed to chance is often due to something over which adequate control could have been exercised. The safety-first movement has demonstrated this beyond a doubt. Almost all the accidents that occur are due to the fact that a task has been done badly or incompletely; a small proportion are due to influences over which at present we can exercise no control. The forces of nature, which in the past have been responsible for many accidents, are now being harnessed and directed by man for his own use. Fire and flood are now our servants rather than our masters. A recognition of our ability to make or mar our lives, according as to how we rely on "our own mental and muscular exertions over the elements of the material world", has resulted in fewer interruptions to work, less pain and disappointment, increased contentment and comfort, and greater wealth.

There is no task in the world that cannot be lightened by adopting the proper mental attitude: that the work is a means to an end. A chaffeur may be bored with his duties; but a New York base-ball fan is not worried unduly because of the journey to the Polo Grounds. If the discontented worker realized that dissatisfaction is cumulative and never remedial he would desist from grumbling; by taking the opposite attitude, involving acquiescence in existing conditions but indicating an ambition to surmount difficulties, he would view his task with less repulsion. By looking ahead, his mind would be taken from the commonplace and the monotonous. It would be well for all of us to realize that a measure of drudgery is the common heritage; I exclude from consideration the individual who has been born with the proverbial silver spoon in his mouth. The work that is being performed daily in the world is the result of employment and occupation the character of which may vary from the fascinating to the congenial; but some tasks are classed as drudgery or viewed with positive disgust. The point that is often overlooked by many who never cease to proclaim their martyrdom to monotonous occupation is that their fellow-men have risen to success —to positions in which their daily labors are a delight and a fascination to them—by using the tasks involving drudgery or distasteful occupation as stepping-stones to more congenial work. There are many who credit success to genius rather than to hard work; they themselves disclaim the possession of what is commonly known as talent, and therein find solace for failure. "Ah! but he has a gift" is an oft-repeated saying to explain the success of the pianist, the actor, the writer, or the artist. The achievement of either appears as spectacular to the layman, who little knows and so cannot appreciate the immense amount of self-denial, drudgery, and attention to monotonous detail that goes to build the foundation of successful achievement and ease of performance. A gift, indeed! Rather an indication of "hard work bravely done".

Others, again, attempt to explain success as due to heredity. That there is something in this notion cannot be denied, but the influence of one's ancestors on personal achievement is slight indeed, especially if what we know of the lives and family histories of famous men be true. In many cases the opposite to what is expected occurs; the son shows no liking or ability to follow in his father's footsteps. A trait may skip one or more generations, to reappear later; but the influence of heredity is invariably over-emphasized. The point that needs recognition is that emulation plays an important part in the formation of character and the choice of work. A boy whose father is a successful engineer appreciates the scope and limitations of such a profession; it is considered natural that he should go and do likewise; his choice is taken as a matter of course. His father, on the other hand, knows what should be avoided in the preliminary stage; his connections are usually such that the development of his son into a full-fledged engineer is facilitated. The boy is spurred to work harder and to take greater pains because of what is expected of him as a son of his father. He is better off than others who have no paternal help or influence; but it is 'slogging' rather than heredity that influences the result.

Our daily routine is generally comprised of work that is disliked or hated, with a leavening modicum of work that is welcome because, perhaps, it can be done well or easily. The secret of success is the power to dispose of the uncongenial task in the quickest possible time; thus it is that the wise man will tackle his hardest problem first. He realizes the moral effect of having overcome obstacles and of having achieved something that he knows is well done. After a while his uncongenial tasks become less formidable; they take less time and involve less labor. He systematizes his actions to such an extent that a new element of interest is introduced. Furthermore, the ability to succeed in a wearisome and uncongenial task shows a capacity for greater and more important duties; his system carries him along the road to success; or his employer notices the improvement, and he is marked for preferment. His querulous fellow-worker, who is forever bewailing his hard fate and the fact that he hates the work, is often inclined to adopt the *mañana* attitude in regard to uncongenial tasks. This is fatal to success. He never acquires the habit of doing things at regular intervals—the surest way to surmount difficulties; consequently, his uncongenial tasks accumulate. The effect of this on the general efficiency of operations is deplorable, and the result is fatal to his chances of promotion. But the worst effect is on the individual's own moral fibre, for every time he procrastinates he encourages his own weakness; he is forced to visualize again and again the unacceptable nature of the uncompleted task before him. He wastes time in denouncing his 'luck', in dilating upon the dreariness of the outlook; he protests that the work he dislikes to tackle will be done tomorrow, forgetful that tomorrow never comes. He suffers from mental fatigue as a result of anticipated toil. This may be reflected in his physical condition; and to lighten the subject with a humorous exaggeration I quote the story of the laborer whose friend remarked that he looked tired.

"Yes," said the man, "it is weary work carrying a hod of brick up three stories."

"Have you been doing it long?", queried the other.

"I start tomorrow," was the reply.

To the one who would succeed, no evasion of the task that lies in his path, however disinclined he may be to perform it, is possible without a loss of moral status. All successful men will admit the force of this truism. Not only must it be done promptly but it must be done to completion; for it has been said that success or failure will result accordingly. A man who performs an uncongenial task quickly, in order to get to work on something that is more interesting, is not deserving of exceptional praise; he looks for no recognition of moral superiority; he merely realizes the fact that by doing so he will save himself much worry and depression. 'Do it now' is a maxim that should be applied with special emphasis to distasteful but inevitable tasks; and although it may not be easy to inculcate good habits in others or to adopt them ourselves, it is exceedingly difficult, if not impossible, to eliminate them after they have been formed. One whose ideas of work are orderly, and who realizes the immense saving of labor and the avoidance of distress and disappointment that result from arranging the daily duties in an orderly way, can seldom be forced to discard his principles. He would, if challenged, disclaim credit for being virtuous in the matter; he has tried both ways, the slipshod and the orderly, and he sticks to his acquired methods because they save him time and labor, worry and disappointment. In olden times, when frugality was not viewed as merely the prerogative of the submerged tenth, children were taught that they could overcome unreasonable fancies by eating first the food they liked least, the result being the development of an attitude of tolerance, and later of partiality, which was healthful. It is the same with work. Life may be likened to a cross-country race, the rewards going to those who take the hurdles and the ditches as they are reached.

However, it is obvious that many classes of labor are depressing and monotonous; there is justification for grumbling. What, then, can be done? Mr. Walter N. Polakov, who read a paper on the subject at a recent meeting of the American Society of Mechanical Engineers in New York, claimed that, in the industrial world, increased production has been sought by devising labor-saving machinery and by stimulating individual productivity. Automatic equipment has to a large extent taken the place of manual labor. Monotonous conditions are the result; the worker has become restless and irritable, which Mr. Polakov attributes to the mechanization of labor. Higher pay and lower working-hours have been demanded, in spite of the fact that quantity and quality have decreased in consequence of concessions already made in these respects. He suggests a remedy—to make the work fascinating, and so to encourage creative self-expression. Studies of the physical condition of some types of industrial worker have shown that much waste of energy occurs from unnecessary fatigue, traceable to mental and nervous depression, and due to the monotony of repetitive operations; the class of worker thus affected, of course, is of the creative rather than of the imitative type. The author of these interesting conclusions found that the most successful and enduring way to promote and to increase industrial efficiency was to improve the status of the worker. "To be specific", he says, "the monotonous physical labor of a fireman is readily transformed, by special training, into a fascinating game based on the exact sciences of physics and chemistry, requiring an exercise of the mental capacities." This is an excellent idea; the inculcation of interest in such work will serve to tide over more quickly that period in the life of the embryo engineer during which he must stoke a boiler; for I feel certain that as soon as Mr. Polakov's fireman becomes interested in the physics and chemistry of steam generation he will cease to be content to remain in so subordinate a position. Further, the exercise of those mental qualities that have lain dormant will quicken his powers of acquisitiveness; this will give him added capabilities, enabling him to seek and obtain a position of greater responsibility and less monotony.

Among the professional classes it usually happens that the urge to make such a change, to set foot on the ladder of success, comes from within and not from without. In this connection it is well to suggest that executives should see that credit be apportioned where it is deserved. The first task of the man in control of the super-enterprise, as well as the one in charge of the business of normal proportions, is to make sure that his employees get a 'square deal', even if he does not know them by sight. This is a responsibility that cannot be deputed without inviting trouble and unfairness. One common attitude should be discountenanced: that the initiative marking the difference between the zealot and the mediocrity should be met, at the hands of subordinate officials, with systematic discouragement. One who is keen about his work and can take pleasure in his task is worthy of more than his hire; he should be protected from the souring influences of petty jealousy and ignorant opposition, such as characterize the internal economy of some organizations. Large numbers of men in important positions in technical work are becoming weary of the sidetracking of credit. Many of them have the scientific spirit, they work primarily for work's sake, unheedful of extra reward; but they are disheartened when recompense is diverted systematically to those least deserving of it. If direct monetary benefit arises from initiative, company executives should see that their technical employees are rewarded in some manner. No unreasonably large compensation would be expected; it would be the honor that would count. But many company officials are so little in character that they prefer to embitter the outlook of a young and promising engineer or technologist rather than give him full credit for the results of his initiative.

In many instances the executives of companies refuse to take out patents on ideas developed by their technical employees and adopted in their own plants; and apparently for no other reason than because they dislike to see the apportioning of credit to a subordinate. By such a policy they save the company a few hundred dollars, arguing that it (neuter gender, having no soul) has the right to the use of the invention without paying royalties to anyone. No company that adopts such tactics has failed to suffer for the attitude. The unfairness rankles. Whether the employee remains with the company or no, he never forgets the injustice; often he stays his hand when to have taken action would have meant the saving of tens, thousands, or perhaps hundreds of thousands of dollars. Some executives fail to realize this. Cases have been known in which the position of the inventor has been made so intolerable that he was obliged to quit, leaving a clear field for those who lacked the mental initiative that arises from perseverance, but whose financial future is secure because of an ability to benefit from what has been developed by others.

Next to the stagnation that results from absence of ambition, there is nothing so harmful to industrial progress as the chloroforming of the initiative shown by technical workers. In the great majority of cases the extra labor starts with no thought of monetary gain, with no consideration of the need for legal protection if a valuable idea be evolved. In few cases is any spur needed other than that which is provided by the anticipated pleasure of successful accomplishment. The work resolves itself into a battle of wits with an imaginary and perhaps non-existant rival who, it is feared, may 'get there' first. It becomes a legitimate race for mental superiority, in which the would-be inventor realizes that all those others can compete, and achieve as much at least as he can, who have discovered the truism that work well done is invariably work that is pleasureable. However, the task in front of him is no light one. He must make exhaustive analyses and mental classifications; he must study every feature of application, not only of his own work but that of others who have preceded him in the same field of action. He must labor with thoroughness to avoid the ridicule that will be showered on him if he fail to anticipate even one minor detail of the sequence of happenings in practice; for there are many who would brand an inventor as an impracticable dreamer. How much work is put to the task before the idea is formulated is known to few. If the result be complex, the idea will stand a good chance of preliminary consideration; the inventor may even escape ridicule at the outset, for the simple idea usually elicits scorn on the part of the drones in the hive—and there are many such—whose policy is to sit back and predict failure. Occasionally their pessimism is justified by later events; they rise to fame thereby and reiterate the well-worn phrase, "I told you so". In the majority of cases, however, the success of the scientist is such that the croaker's objections are forgotten; if challenged he will always maintain that, in his employer's interests, he must be cautious.

The value of the idea having once been developed, all efforts are made to secure the benefits without return to the inventor. In some cases this is an easy matter, for an unscrupulous lawyer will, for a consideration, draw up an agreement by which the employee signs away his mental as well as his physical powers. Such a document, usually of innocent if not benevolent appearance, requires an intensive examination at the hands of one versed in legal jargon before the unconscionable nature of its clauses can be discovered; and company officials of a certain type see that the employee agrees to the terms before he has an opportunity to obtain legal advice. Many companies are inequitable in their dealings with technical employees who show initiative; this is seldom the fault of the high executives; it is usually the result of obstructive tactics on the part of subordinate officials, who if they cannot deflect credit in their own direction or in the direction of their 'loyal' assistants will kill the initiative of others who are under their control. Nothing is more pathetic than the inescapable fact that in these times when co-ordinated and intensive effort is needed, the ambitious so often find that the ladder of success is enmeshed with barbed wire. The gospel of work and loyalty is preached in season and out of season, and yet the hardest and most exhausting labor—invention and creative effort—meets with the least reward. The technical worker with initiative and ambition often finds that those who spend their time in scheming to retain the esteem of the high officials of the company that employs them are as well off financially and better off in so far as security of tenure is concerned. If inventive initiative were rewarded by adequate recognition, the technician would in most cases feel content, for it would mean an official acknowledgment of his perseverance and capability that would help him professionally. Instead, however, the main idea seems to be to keep the origin of the improvement in the dark, so that disparagement may meet with little opposition. Between the birth of an idea and its application on a working scale there is often an interval of considerable duration, in which much may be forgotten.

If the technical worker with initiative be systematically discouraged, what can he do? To prevent the stealing of ideas by unscrupulous associates he can make application for patents at his own expense. If he does so he is likely to be accused of taking a mercenary view of his work, in contrast to his oft-repeated claim that he labors as a scientist for the love of achievement and primarily for the advance of his art. Further, if he takes such a course, a rift occurs immediately between him and the company officials that were disinclined to take action or to support his claim to originality. A striking example of this came to my notice recently. Several years ago an engineer devised, after much expense and patient research, something that afterward proved of distinct merit and value. For two and a half years he offered the idea gratis and unconditionally to those most interested in its application to the industry in question. His altruism, however, met with less than a response; it was greeted with discouragement and even discourtesy. Some years later the principle upon which he had insisted was recognized and his ideas were adopted; for a number of reasons his name was associated with patents applied for long after the idea had been offered gratuitously to the industry. For this 'mercenary' attitude he was the subject of anonymous attacks. The same motive might have been attributed to the gentleman who for a wager tried to sell newly-minted golden sovereigns on London bridge for one penny apiece; and who, when he was unsuccessful, returned the money to his bank. Truly the worker who invents has a hard row to hoe; Goodyear's experience is being repeated daily. This fact suggests that labor is its own reward among one section of our workers. The spirit of scientific research is weakened too often by derision, for a certain type of individual considers an inventor as crazy; when the idea reaches the practical stage the inventor is denied encouragement, recognition, or adequate reward. Rear-Admiral Bradley A. Fiske, the inventor of the electric range-finder, the naval telescope, and a host of other important improvements in the science of navigation and naval warfare, was recently asked by 'Popular Science', "What is the most pressing scientific achievement . . . deserving the first attention of American inventive genius during 1922?" To this he replied: "An invention by which inventors will acquire an influence in the world proportional to the benefits they confer". I discussed this matter recently with a technician of initiative and sterling personal character. He said, "My son will have none of the disheartening and discouraging opposition in life that I have experienced. I intend to see that his choice of a profession is one in which recompense is automatic—the result of attention to routine—and in which little or no differentiation of capabilities is possible as a result of the development of initiative or inventive effort". Impressions such as these draw attention to a pathetic aspect of modern technical work; they constitute a regrettable commentary on existing conditions. In England the National Union of Scientific Workers has come into being as one of the sequelæ of conditions that have enriched Capital and Labor at the expense of the upper-middle classes. The Union has done and is doing excellent work, having laid down several basic principles according to which the inventor should be rewarded. The modesty of the demands, if such they can be called, indicates that the inventor has received neither recognition nor reward in any way commensurate with his contributions to the advance of civilization and the comfort of humanity. It is evident that weight of aggregate opinion and influence is needed to counteract such injustice. Argument has been advanced that membership in a union lowers professional standing; but the success attending the new movement in England is sufficient refutation, for the British organization contains many men of exceptional mental and moral fibre, whose professional standing is as high as it was when the scientific worker was helpless in the hands of the unscrupulous promoter. In other fields of endeavor it is evident that unionism, as a principle, is desirable; it is a help rather than a hindrance to industrial advance. Why should scientific and technical workers be debarred from such a method of obtaining the benefits of mutual support and corporate defence?

The importance of research and invention in reducing the expense of industrial operations is emphasized forcibly in a statement recently issued by Mr. Frank Hedley, the president of the Interborough Rapid Transit Company, of New York. In dealing with the question of the cost of labor in the near future, Mr. Hedley stated that devices have been installed by his company that will reduce considerably the present expenses. One item of $550,000 is expected to be saved in wages during the six months ending June 30, 1922, by the adoption of a new system ensuring the automatic control of the opening and shutting of car-doors; an additional $125,000 is to be lopped from the operating costs at the stations by means of a special type of turnstile. The passenger of today, instead of having to buy a ticket from one employee and deliver it to another, deposits a nickel in a slot, whereupon the turnstile is automatically released, thus permitting passage to the station platform. The adoption of such innovations indicates that bedrock costs may not have been reached in any industry, however economically it may appear to be operated. Many executives would do well to realize that the encouragement of new ideas and the fair treatment of inventive genius are more likely to result in cheap and efficient industrial operation than will the adoption of a cheeseparing policy of economy in wages and salaries.

To those scientific workers who seek encouragement, I quote from an editorial that appeared in a recent issue of the 'Commercial and Financial Chronicle' of New York. In this we read: "Life is a trust; wealth is an obligation; work only is duty. Waste is work without thought. He who slights his task and skimps his hours deprives his time and place of its full accomplishment: he takes more than his share from the whole. Poor or rich, a man works with his own mind and strength. He may use one more than the other, he cannot use one and not the other. The power of strength is labor; the power of thought is capital; together they constitute being. Work is the foundation of our civilization—wisdom is no more, culture is no more. We are given dominion only through work". Again, "The curse of our time is the vast army of people who care nothing for their work", said Mr. David Belasco at a dinner in honor of the fortieth anniversary of his career as a producer of plays. He believes that we were made to work, that we should love our work so that we might play at it, "find real and profound pleasure in it; and so labor on until, tired out, we might sleep like little children at the end of each day". The distinguishing feature of American business and professional men is the interest they take in their work, even in so-called leisure time. For the benefit of those at the bottom of the ladder an element of attraction can be introduced that will do much to hasten the transition of laborer to artisan, to mechanic, or to technologist. When the scientific spirit has been aroused, and when ambition and initiative are sprouting, let it be seen that encouragement is not lacking, that petty jealousies are killed by healthy public opinion, and that some meed of recognition, if not adequate financial reward, goes to the worker in the technical field of research.

Mica

*The micas are crystalline silicates of aluminum and other metals, notably potassium, sodium, magnesium, and iron. They are characterized by a perfect basal cleavage, in consequence of which they can be split into thin plates. These plates are highly transparent when free from iron and other impurities. They are elastic, and possess remarkable insulating properties. The chief commercial varieties are muscovite, or potash mica, and phlogopite, or magnesia mica. Muscovite is the most widely distributed variety. It is usually colorless and transparent when in thin plates, and generally occurs as 'books' in pegmatite veins associated with granitic intrusions. Phlogopite, though sometimes white or colorless, is often brown, and is then known as 'amber' mica. The commercially important deposits of this mineral occur associated with rocks rich in magnesia, especially pyroxenites. Lithia mica (lepidolite) is utilized as a source of lithia.

The transparency of mica sheets is often destroyed by imperfect development or by impurities taken up during the process of crystallization. Such inclusions frequently appear as films between the cleavage-plates. Muscovite is particularly liable to be spotted and stained by iron oxide and other impurities. Such stains often render the mica valueless for economic purposes, unless they can be removed during the process of splitting. The micas vary considerably in hardness. Even in the same sheet the edge-hardness and the face-hardness differ. The edge-hardness of muscovite is greater than that of copper, whereas that of phlogopite is almost the same as that of copper. Hence phlogopite is employed in dynamo-electric machinery even though its electrical and heat-resisting powers are inferior to those of muscovite.

Clear sheet mica commands a high price for stove and furnace doors, for gas-lamp chimneys and shades, and other purposes. The chief use of sheet mica, however, is for electrical purposes as an insulator. During the War it was used for gas-masks.

Sheet mica is used largely for:

(1) Separating the commutator segments of dynamo-electric machinery. A soft mica is best for this purpose, as this ensures equal wearing of the copper segments and the mica separators. Consequently phlogopite or a soft muscovite is in greatest demand for this purpose.

(2) Electrical heaters and cookers, and pyrometers.

(3) Electrical condensers.

(4) Sparking-plugs and magnetos.

(5) Washers, and insulation of bolts and screws.

For all the above, as indeed for most other purposes, it is necessary that the mica should split easily. It should also be free from cracks and conducting inclusions. Sheet mica less than 2 by 4 in. is almost useless for the purposes specified. Discs and washers punched from mica sheets are also used in arc-lamps and gramophones, and smaller ones in the sockets of incandescent lamps. Flexible mica-covered cloth and tape find various uses in electrical apparatus.

Formerly only sheet mica measuring 2 by 4 in. and upward could be marketed readily, and much material of smaller dimensions was sent to the waste-dump. At the present time, owing to the method of building up mica sheets from thin plates of scrap mica suitably trimmed and cemented with shellac, the greater demand in the industry is for splittings less than 2 by 4 inches in size, which can be compressed hydraulically and cemented with shellac into sheets of any desired thickness or size, or molded to various shapes. Such material, known as micanite, has now largely replaced sheet mica in commutators.

An important use of micanite is for the insulation of the conductors in high-tension alternators in which sheet mica cannot be used. The micanite is made in large thin sheets and is wound around the conductor by means of special machinery, the insulation being completed by heating under pressure. Alternatively, tubes are made in a similar manner, and the conductors afterward inserted. Micanite is largely used for marine switchboard insulators. The use of micanite is rapidly extending in the electrical industry; and consequently the chief demand is for mica splittings. Ground mica pulverized from mica scrap is used for a variety of purposes, the principal of which is to impart a lustre to wall-paper. Only the finer grades passing 160 to 200-mesh screens are suitable for this purpose. Other uses for fine-ground mica are as a component of paints and as a lubricant.

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*Abstracted from a bulletin by the Imperial Mineral Resources Bureau.

Glass

By P. B. McDonald

Several months ago the 'Press' printed some letters concerning the cause of the purplish tinge in old glass, and it was explained that this color was due to the weathering of manganese introduced as an oxide to neutralize the green color of ferrous oxide existing as impurity in the materials from which glass is made. These letters served to remind the engineer of something of his dependence on glass, for he is indebted to it for optical instruments, test-tubes, bottles, windows, and many other things. Moreover, the processes of making glass have a relation to mining and metallurgy. Recently I heard a lecture on 'Glass in All Ages' by Professor Silverman of the University of Pittsburgh, one of the foremost American authorities on glass, and I have seen the glass exhibit in the Metropolitan Museum of Art, reputed to be one of the finest in the world.

Though everyone is familiar with the properties of glass, it may be interesting to recall some of them. Glass is a poor conductor of heat, as is seen when a boiling-hot liquid is poured into a thick glass vessel and the vessel breaks because of unequal expansion of the inner and outer layers. In the manufacturing process, glass is annealed to make it less brittle, that is, to permit the constituent particles to settle into equilibrium. Glass has a curious and important viscosity when molten. A mass of viscous glass can be rolled like dough, blown hollow by the breath, or forced to take the shape of a mold. This condition of viscosity is intermediate between solidity and fluidity. Molten glass at a high temperature can be drawn into a filament elastic enough to be woven into a fabric. So-called mineral wool is made from the slag-glass refuse of iron smelting, being blown into fine shreds; it is used as a fire-proof and rat-proof padding for walls and floors.

Glass was made by the ancient Egyptians probably as early as 4000 B.C. The ancients, however, used glass for making ornaments, vases, and imitation jewelry down to the time of the Romans, who began using it for windows. The Egyptians preferred highly-colored glass, and clear glass was not sought until the Hellenistic period, when glass mirrors became fashionable. Glass-makers in the Phenician cities of Tyre and Sidon understood the value of manganese in making glass clear—the very point discussed in the 'Press' 2000 years later when inquiry was made as to the purplish tinge of old glass. The effects of weathering on old Roman vases is illustrated in the beautiful iridescence like "opaline dove's-neck lustres, hovering and evanescent" on some of the glass exhibits in the Metropolitan Museum of Art. The coloring agents are metallic oxides.

The Encyclopædia Britannica says of the Roman use of glass: "It may appear a somewhat exaggerated assertion that glass was used for more purposes, and in one sense more extensively, by the Romans of the imperial period than by ourselves in the present day; but it is one which can be borne out by evidence. It is true that the use of glass for windows was only gradually extending itself at the time when Roman civilization sank under the torrent of German and Hunnish barbarism, and that its employment for optical instruments was only known in a rudimentary stage; but for domestic purposes, for architectural decoration and for personal ornaments glass was unquestionably much more used than at the present day . . . Colored and ornamental glass held among them much the same place for table services, vessels for toilet use and the like, as that held among us by porcelain . . . Glass was largely used in pavements, and in thin plates as a coating for walls . . . Imitations of porphyry, of serpentine, and of granite are also met with, but these were used chiefly in pavements, and for the decoration of walls, for which purpose the onyx-glass was likewise employed". The word "pavements" as used here undoubtedly means floors, such as for baths or palaces, or what we call 'sidewalks'.

The New International Encyclopædia remarks about ancient Roman glass: "Under the favorable conditions the industry flourished greatly, and glass became so cheap that ordinary cups or platters were sold in Strabo's time for a farthing. On the other hand, the expensive and beautiful vessels, according to Pliny, had almost driven out the use of gold and silver".

As to the chemical composition of glass, it is a fused mixture of two or more silicates, and may be named from the predominant base, as soda glass, potash glass, lime glass, or lead glass. The essential ingredients are silica and alkali. Ancient glass was usually a potash glass, but Leblanc's discovery in 1792 of a method for obtaining sodium carbonate from salt opened a new era in glass-making. Flint glass broadly includes all glass except window-panes and dark bottles, that is, cut glass, optical glass, artificial gems, and fine dishes. The distinguishing constituent of flint glass is lead oxide (litharge), which imparts a heaviness and brilliancy to the product. The English began to make flint glass in the 17th century, but Professor Silverman declared that the Chinese had made it centuries earlier. A cheap variety of flint glass known as lime-flint glass, in which lime replaces the lead oxide, has become popular of recent years, especially in the United States. Crown glass is soda-lime silicate blown in pherical form and flattened to a disk by a spinning motion of the blow-pipe; once the favorite glass for windows because of its brilliancy, it is now made only for ornamental purposes, as the plates are small and of tapering thickness. Molten material of much the same composition is now made into sheet glass; it can be blown by machinery and does not require the services of such skilled and muscular workmen as when blown entirely by the human breath. Plate glass, likewise, has approximately the same composition (that of a soda-lime silicate), but when molten it is poured over a smooth metal casting-table, on which a heavy roller spreads it to a uniform thickness. It is then annealed for several days, and polished with sand, emery, and rouge; the vigorous polishing removes 40% of its thickness.

Wire-glass, well known to the engineer, may be made in much the same manner as ordinary plate glass with the addition that a woven wire net, heated nearly as hot as the molten glass, is pressed into the rolled glass on the casting-table; or the wire net may be inserted between two layers of plate glass. The iron of which the net is composed has a higher fusing-point than the glass, and when exposed to fire will retain its shape and hold the glass together even after the latter has become plastic. In the San Francisco fire, a building equipped with wire-glass survived in the midst of smoking ruins, because the panes did not fall out, although the glass cracked.

The history of glass-making is full of dramatic and remarkable episodes. Glass-makers have always held a high position in the community. Constantine gave studios in a special quarter of Constantinople to glass-makers, and exempted them from tax. When Venice became famous for fragile and elegant glass in the Middle Ages (a reputation that it still retains), the secrets were guarded jealously. A Venetian glass-maker carrying his skill to another country was followed and ordered back, by command of the Council of Ten. A wandering Venetian glass-maker called Paoli was tracked to Normandy where he was stabbed with a dagger on which was written "Traitor". On the other hand, Venetian nobles gave their daughters in marriage to glass-workers, and the children were counted of the nobility—an honor that even mining engineers have not today. Though glass may have been made in England before the Roman conquest, oiled linen was the usual window material there as late as the 16th century, and students in the medieval universities usually had no glass and no fire in their bedrooms. Pressed glass is the typical American contribution to the industry; flint glass is pressed while red-hot into the mold of an inkstand, dish, goblet, vase, or statue. By this means unskilled labor can produce excellent results, although the lustre is less than on cut glass and the angles are rounded. Cut-glass is first blown, and then ground into glistening facets. Ordinary glass tumblers are made nowadays by pressing in molds rather than by blowing them as in old-fashioned times; hence the low prices.

THE Arkansas Diamond Co., Little Rock, Arkansas, which owns the Arkansas mine, in Pike county, continued testing by pits and washing by hand in 1920 and is reported to have recovered diamonds valued in the rough at several thousand dollars, states a U. S. Geological Survey bulletin. Operations on a larger scale have been planned, and at the present time (October 1921) the company is reported to be installing new machinery in its screening and jigging plant for washing the surface material in the field. The concentrate from this plant will go to the grease-tables. In September 1921 the laborers digging test-pits on the property are reported to have picked up a white diamond weighing 20¼ carats. The Kimberlite Diamond Mining & Washing Co. reports that the company holds a lease on the Mauney mine and owns the Ozark and Kimberlite mines, at Murfreesboro, Arkansas. Its two testing plants, which were destroyed by fire on January 13, 1919, have not been re-built, but further exploration work was carried on; and, as soon as conditions become normal, activities will be resumed on a larger scale. In the recoveries of gem material the deep canary color and the mahogany shade of brown are said to be especially worthy of mention; blue or pink stones and occasionally a frosted or etched white stone are also reported. Fragments and fractures were noticeable in the surface-material but with slight depth in the undisturbed volcanic ground these features have almost disappeared. From a careful analysis of several thousand diamonds it is reported that on a color basis the mine-run yields white stones 40%, brown 37%, yellow 22%, and bort 1%.

INVESTORS outside California, no less than residents of the State, have little conception of the possibilities still dormant in the tremendous bodies of Tertiary and Quaternary gravels which are as yet unworked in its borders, states Chas. S. Haley in a recent bulletin published by the California State Mining Bureau. Conservative estimates of the amount of gold which can still be obtained vary from one to three billion dollars. In view of the fact that the State's total production of gold since 1848, from both quartz- and placer-mining operations, is about one and one-half billions, these figures are significant as indicative of potentialities. An investigation is now being undertaken by the Bureau with the object of determining the available placer resources of California and of indicating the best and most feasible means of working them. A plan is being worked out that will be not only of benefit to the mining industry, but, so far from being detrimental to agricultural interests, will be of definite benefit to them also. In order to take advantage to the fullest extent of the present revival of interest in gold mining, it is extremely desirable that this report shall be available by the spring of 1923. For this reason, the utmost co-operation is desired from the citizens of the mining counties of the State, and from all who are interested, directly or indirectly, in the revival of the industry. Already in covering the Feather river, Klamath river, and Northern Sacramento river areas, several large deposits of virgin gravel have been encountered of which little information has ever been published, and on which scarcely any prospecting has been done. The report will be devoted more to the economic side of the question, although the work of able geologists will be freely drawn upon wherever it has a direct bearing upon the profitable operation of the gravels.

THE exports of minerals from China during the year were of considerable importance, and indicate that there has been some development of the natural mineral resources of the country, states a consular report. This statement should not be regarded as very optimistic, because, considering the mineral resources of the country waiting for development, the quantities of exports are still small. This list of exports includes antimony, copper, pig-iron, iron ore, lead, quicksilver, tin, and zinc. All, with the exception of copper and quicksilver, show substantial increases in exports.

Revision of the Mining Law

The Mining Law Revision Committee of the Columbia Section, A. I. M. & M. E., has prepared a detailed critique of the Arentz Bill. The Committee consists of Francis A. Thomson (chairman), Stanly A. Easton, James F. McCarthy, Jerome J. Day, J. C. Haas, and W. H. Linney. The chairman of the Section, Rush J. White, and the secretary, L. K. Armstrong, concur in the Committee's report.

As a summary of its findings the Committee has issued the following statement:

In general the committee does not believe the present law is so perfect that no improvement is possible, and it therefore favors the enactment at this time of the following portions of the proposed law.

(1) The provision for recording of claims in the U. S. Land Office, the burden to be placed, however, on the county or district recorder and *not* on the prospector.

(2) The disqualification from re-location for one year.

(3) The specification that monuments shall govern descriptions, and

(4) With certain reservations the plan for allowing extra land in lieu of the present mill-sites.

The Committtee is opposed to the following clauses:

(1) The requirement for orientation of claims.

(2) The certification of discovery by a mineral surveyor.

(3) The restrictions on locations in Alaska.

(4) The proposal for the creation of a mineral development fund, and all cash payments upon which it would be based.

On the two most important points, namely, location without discovery and the proposed abolition of the apex right, the Committee reached an amicable disagreement.

On the first point the report states:

"One section of the Committee believes that the need for location prior to discovery is more apparent than real; that practically any ground in a mining region will show sufficient color of discovery to justify locations as at present made; and that, furthermore, public opinion gives apparently sufficient protection to any locator while actually doing work, irrespective of the validity of his discovery.

"Another section of the Committee feels that there is need both for location and for patent of ground which, while not necessarily of direct value for its mineral content, is needed for protection and exploitation of known deposits, as well as for more certain title to the ground of probable but undemonstrated mineral content of potential value."

On the second point the report states:

"With regard to the abolition of the extra-lateral right your Committee finds itself unable to report a unanimous conclusion. Most of us admit that for a new country, the square location with vertical boundaries is preferable, although certain members of wide experience and large interests hold the opposite view.

"As to whether at this late date it is desirable to change the law we are still more divided. We do agree, however, that should the extra-lateral right be abolished, then the provisions of the British Columbia law should be followed and that claims 1500 ft. square should be allowed, laid out with reference to the lode and not to the cardinal points."

As to the other points of the proposed law, the Committee in effect feels that they are either negligible or dependent on clauses discussed above.

The following general comments are made:

"Your Committee further feels that it is no reflection upon the eminent gentlemen who compiled the proposed law to say that their point of view is radically different from that which actuated the makers of the law of 1872, and the framers of the Miners Rules and Regulations upon which it was built. We are forced to the conclusion that the present framers have most naturally, in large measure, and with considerable justification, ignored the individual locator and prospector, and framed a law designed mainly for acquisition and exploration by organizations of considerable capital. It is evident, of course, that much of the prospecting of the future will be of a kind beyond the scope of the prospectors of the past; at the same time, your Committee does not believe that we have yet reached a place in our development where the small man can be entirely relegated without detriment to the mining industry.

"Concomitantly with this it seems to us the Bill contemplates a further extension of the regulatory powers of the Land Office and similar organizations, and to your Committee, all of whom have lived and operated within the confines of the National Forests, further extensions of the exasperations and annoyances, opposition and apathy inflicted upon persons engaged in mining development in these areas appear suicidal.

"All of us deplore the decline of prospecting. To encourage it requires helpful stimulation, not further regulation and restriction by unsympathetic and uncomprehending jacks-in-office. The wild free days of the early West are, of course, gone forever, but we need not swing from that extreme to one of officialdom bristling with 'verbotens' of one kind and another.

"In conclusion, it appears to your Committee that one of the greatest difficulties connected with mining litigation is the method of court procedure, and we as a constructive measure desire to embody as a rider to this report the suggestion put forward by the chairman of this Committee with regard to a modification of present procedure, with the earnest recommendation that serious consideration be given to the best method of putting it into practice."

The suggested plan of court procedure is outlined by Mr. Thomson as follows:

"It is evident to all of us, I think, that the present procedure is an unsatisfactory one, in that non-expert judges are called upon to decide between the conflicting testimony of expert witnesses for each of the opposing sides. The proposal, frequently made, of the employment by the Court of a committee of unprejudiced experts to act as *amici curiae* is open to the objection, I believe, as pointed out by Mr. Rush White, that these experts, not being under the pressure and necessity of presenting all of the technical details of the case, are apt to overlook or fail to bring out apparently insignificant technical points which may be of great legal significance. As an alternative to this plan. therefore, I would like to suggest for consideration a plan based upon and modeled after that employed in the British Admiralty courts, in which the judge assigned the cases appoints or selects two experienced mariners—usually retired sea-captains—to sit with him on the bench. These men are called 'assessors'. Such assessors have the same privileges which the Court has of interrogating witnesses, examining exhibits, etc., and virtually become. for the particular trial, a part of the bench. In such a procedure the judge is manifestly greatly helped by the technical knowledge of his two assistants or assessors. and is saved from the obvious embarrassments of having to decide between the complicated and often contradictory expert testimony of two equally distinguished witnesses. The assessors do it for him. In mining cases it seems to me the procedure should be to provide for the selection by and at the option of the Court of two men thoroughly versed in the technical points involved in the case under trial to sit with him in the same way that the assessors sit on the British Admiralty courts. The remuneration of these assessors would, of course, be a proper charge against the costs of the action, and I am inclined to think that by the time such a plan had been in operation for a few years there would be shown a marked improvement in the conduct of such cases, more confidence in the decisions so rendered, fewer appeals, and less time lost in trying cases."

Mining in California During 1921

Deposits of precious and base metals scattered throughout eight counties have been a most potent factor affecting their early settlement and present development, states a California State Mining Bureau bulletin. This is particularly true of Shasta, Siskiyou, and Trinity counties. Lumbering, stock-raising, and agriculture share the honors somewhat in Humboldt, Del Norte, Tehama, Lassen, and Modoc counties. The district as a whole is predominantly a metal-mining area, although in the five counties last mentioned the value of structural and industrial minerals occasionally exceeds that of the metallic.

The principal metals mined are copper, gold, platinum, silver, and zinc. There has been little change in the copper situation during the year. One or two mines, like the Blue Ledge in Siskiyou county, which operated during 1920, added their names to the list of those already closed down, and it is expected that the copper production for 1921 will be even less than that recorded in 1920. The consensus of opinion seems to be that there will be little resumption of copper mining in the United States before the middle of 1922. The mines of this district are not included in the so-called low-cost group, and therefore probably face at least another year of inactivity, unless there is a marked improvement in the copper market.

Three companies, the Mammoth, Mountain Copper, and Balaklala, asked for heavy reductions this year in assessed valuation for taxes, the aggregate reduction requested being $1,089,304. After hearings, the Mountain Copper Co. was granted a reduction of $89,200 on its Iron Mountain mine. For the United States Smelting, Refining & Mining Co., the Mammoth group was reduced from $449,060 to $275,000 and the Sutro from $58,160 to $40,000; the Keystone remained unchanged at $32,000. The Mammoth's improvements were also reduced $89,920. The assessed valuation of the Balaklala mine was cut from $262,160 to $175,000.

Outstanding features of the gold-mining industry during 1921 were the comparative improvement in Lassen and Modoc counties, particularly at Hayden Hill; increased activity in quartz mining in Siskiyou county, notably in the Salmon River district and near Callahan; capital investments and the re-opening of a number of properties in Shasta county, in the French Gulch district; and the fairly steady production from the mines and dredges of Trinity county. Dredge operations in both Trinity and Shasta counties have remained nearer normal during the depression than any other form of gold mining. One new dredge is in course of construction in Trinity county and several possible dredging areas in Shasta and Siskiyou counties have been under investigation. The outlook for 1922 for this form of exploitation is good.

Hydraulic and placer mining, mainly confined to the drainage basins of the Klamath and Trinity rivers, shows little sign of improvement and there appears to be a strong trend toward quartz prospecting and quartz mining even in the heart of the alluvial mining area. Lode mining gained impetus during the current year and more activity is looked for in 1922 than for the past five years. The platinum-group metals, including platinum, iridium, osmium, and palladium, are produced mainly by the gold dredges in Shasta and Trinity counties. The high price of these metals in 1920 and the early part of 1921, however, stimulated platinum prospecting, and a number of individuals began producing. The principal diggings were along Beegum creek on the Shasta-Tehama county line, and on the lower South Fork of the Trinity river near Hyampom. The native metal in Beegum creek assays from 13% to 20% platinum, and 75% to 85% osmiridium; the high price of iridium made it possible, for a time, for some individuals to realize as much as $20 per day. There is a probability of machinery being put on Beegum creek next year to handle the ground, and the production from this source will probably increase in 1922, although lower prices during the latter part of 1921 may discourage those who hold the poorer ground. The production for the year as a whole, from both dredges and individuals, should equal or slightly exceed that for 1920.

REVIEW OF MINING

MR. SPURR MEETS MEMBERS OF THE SAN FRANCISCO SECTION OF THE INSTITUTE

J. E. Spurr, Editor of the 'Engineering & Mining Journal', met the Local Section of the Institute at an informal meeting on March 6 and delivered an interesting address, which dealt chiefly with two topics: the present condition of the mining industry and the publishing activities of the Institute. Albert Burch was in the chair and a number of members took part in the discussion. The meeting was one of the best that the Local Section has had for several years. Mr. Spurr returned to New York this week.

COPPER PRODUCTION STATISTICS

A survey of the copper situation is made by the 'Boston News Bureau'. The prediction is made that by the end of the summer there will be close to 70,500,000 lb. of copper coming on the market. The Hayden-Jackling porphyries alone are the only large units which steadfastly refuse to be stampeded into operation. The recent recession of the price of metal from 14c. to 12¾c. can be ascribed to the belief of consumers that when production begins the output will be more than large enough to take care of immediate needs.

Unless something unforeseen occurs, copper will be coming from the mines and smelters in substantial volume by late summer. Already 13 mines have either resumed production or are preparing to resume. With the nine properties which did not join the rest of the mining fraternity in closing down last April, there will be 23 mines producing within a few months. The probable output at that time is equivalent to about 51% of the average capacity of these 23 mines. The table below shows those producers resuming, together with the current monthly output of those properties that were kept open; also the normal capacity. The figures are in pounds:

	Last full month	Monthly capacity
Ahmeek	1,863,900	2,000,000
Anaconda	11,600,000	30,000,000
Arizona Commercial	700,000	1,000,000
Calumet & Arizona	3,000,000	5,900,000
Calumet & Hecla	4,671,984	6,900,000
Cerro de Pasco	*4,726,000	7,325,000
Copper Range	2,500,000	4,500,000
East Butte	*1,100,000	2,500,000
Granby Consolidated	*2,700,000	3,300,000
Greene-Cananea	3,700,000	5,700,000
Inspiration	5,000,000	11,900,000
Isle Royale	859,200	1,600,000
Kennecott	*4,760,000	10,750,000
Miami	*4,000,000	5,300,000
Mohawk	*1,200,000	1,400,000
New Cornelia	*2,000,000	1,400,000
Old Dominion	2,199,000	4,400,000
Phelps Dodge	9,244,000	21,700,000
Quincy	*1,300,000	2,000,000
United Verde Extension	3,000,000	5,100,000
Wolverine	*350,000	400,000
Total	70,474,084	137,975,000

*Present output monthly.

HOLLINGER CONSOLIDATED COMPANY WILL INSTALL NEW EQUIPMENT

In consequence of results obtained in a single unit last summer, the Hollinger Consolidated Mines Co. at Porcupine has decided to install six new filters in its cyanide plant. The experiments indicated that the loss of dissolved gold in the tailing averaged at least 20c. per ton, although the pulp was passed through a series of thickeners for counter-current decantation. It was demonstrated that the filter could recover almost all of this gold and that a unit could handle 650 tons of dry slime per day. In fact, this capacity could be increased without sacrificing efficiency in washing. The density of the filter-pulp was 1.2 part solid to 1 of solution. The six new units will be furnished by the Oliver Continuous Filter Co.; the size of the drums will be 14 ft. diam. by 16 ft. long. The filters will be equipped with a new type of oscillating agitator and the cake will be washed with the improved atomizing spray to about 20% moisture.

PHELPS DODGE COPPER WILL GO HEREAFTER TO THE PERTH AMBOY PLANT OF THE A. S. & R. CO.

The Phelps Dodge copper-selling agency soon will dispose of its metal to the Perth Amboy refinery of the American Smelting & Refining Co. under a three-year contract. Heretofore shipments have gone to the Nichols Copper Co. plant. After it had attained capacity for producing 30,000,000 lb. of copper per month the Laurel Hill, Long Island, refinery of the Nichols interests attained and kept for some time the premier position among the country's copper plants. But the enormous demand during the War changed this condition and other refineries forged ahead of the Nichols plant in point of capacity.

More than a year ago the American Smelting & Refining Co. closed down its Perth Amboy copper refinery and concentrated its eastern activities at the Baltimore plant, now the largest in the world. Not only will the product from the various Phelps Dodge mines and smelters swing over to the Perth Amboy refinery from the Nichols plant, where it has been treated for many years, but the other properties selling their copper through the Phelph Dodge agency will also ship to the Guggenheim plant. They include the Calumet & Arizona, Old Dominion, and United Verde Extension companies which have been marketing through the Phelps Dodge Corporation. These properties in conjunction with the regular Phelps Dodge branches can produce well over 200,000,000 lb. of copper per year.

NEW MILL AT THE PREMIER MINE IN BRITISH COLUMBIA IS UNUSUAL PLANT

A satisfactory solution of the metallurgical problem has been achieved by the Premier Gold Mining Co., operating in the Salmon River district of British Columbia. At present 100 tons daily of high-grade ore, $100 per ton or better, goes to the Tacoma smelter. From 50 to 100 tons daily goes to the Granby smelter at Anyox, B. C. This is silicious ore assaying about $50 per ton. About 100 to 120 tons of ore, that with the highest pyrite content, ranging from $30 to $60 in grade, goes to the mill. Such has been the arrangement since the new tram from the mine to tidewater went into operation about January 1. For several months prior to the completion of the tram ore ranging from $110 to $160 in assay-value per ton was milled. The flow-sheet of the mill is unusual. The equipment includes gyratory crusher, rolls, Marcy mill, Wilfley concentrators, re-grinding tube-mill using 1-in. balls, three K & K flotation roughing-machines, and one K & K machine used as a cleaner. This flotation scheme is followed by a standard Dorr counter-current cyanide plant.

The tables and the cyanide-plant are chiefly relied on to save the gold, while by far the largest part of the silver is lifted in the flotation froth. Grinding is done in cyanide solution, and the Premier mill is probably the only mill that carries on flotation in cyanide solution.

INTERNATIONAL SMELTER AT TOOELE, UTAH, WILL BE RE-STARTED

Plans are being made by the International Smelting company to resume operations at its Tooele plant about the middle of May. Operations were suspended at this smelter last July because of a scarcity of ore. With a resumption of operations at Butte, the International Smelting Co., which is a subsidiary of the Anaconda Copper company, has decided to resume operations. Existing contracts which have been kept in force during the period of suspension at the Tooele plant and others recently acquired by the company guarantee a sufficient tonnage of ore. Operated at capacity, the International smelter employs 1200 men. During the period following the signing of the Armistice, about 600 men were employed at the plant. The copper department of the plant is equipped with 32 McDougall roasters; the lead plant, with blast-furnaces and sinter-plant.

PROPOSED MERGER OF ARIZONA COPPER MINING COMPANIES

A proposal has been made that a merger be effected to include Old Dominion, Arizona Commercial, Superior & Boston, and Iron Cap Copper companies, whose mines lie contiguous to one another in the Globe district of Arizona. The parties in interest have all acknowledged that they are open to such a proposition. These four properties are all situated on the same system of veins stretching from the Old Dominion property in the west to the Superior & Boston in the east. The operating economies resulting from such a consolidation would be obvious; greater surface area would be available; workings of all could easily be connected, giving continuous openings through all four properties, with greater accessibility and consequent lowered operating costs. The Iron Cap Copper Co. has earned and paid dividends in normal times and with its new mill of 375 tons daily capacity would be an adjunct to the consolidation. Old Dominion, with its mill and smelter, would provide the bulk of the reduction facilities for the new company. It has developed over 1,400,000 tons of ore averaging 3½ to 4½% copper.

Arizona Commercial has developed its property by two shafts with a continuous orebody from the 4th level down to the 16th and over 650,000 tons of ore blocked out and ready for extraction, estimated to average between 5 and 6% copper. In effect, if a consolidation results the merged company would have the facilities for a production of about 60,000,000 lb. of copper per year.

ANACONDA COPPER COMPANY RESUMES OPERATION AT GREAT FALLS

Operation has been resumed in the electrolytic department of the Anaconda company's copper refinery at Great Falls, Montana, and the furnace department will be going soon; this means that the whole of that plant will be in operation, although not at capacity. The company's contract for the treatment of zinc concentrate from the Butte & Superior mine calls for an output of from 6,000,000 to 7,000,000 lb. of zinc per month, and soon Butte & Superior will be shipping approximately 1000 tons of ore daily. Seven Butte mines of the Anaconda company are now producing between 5000 and 6000 tons of ore daily, and the tonnage is steadily being increased. Anaconda is employing about 5500 men in its Butte properties, and crews are being enlarged as men apply for work. When the mines first opened new men came into Butte at the rate of 100 daily, but arrivals now daily number about 60.

CONSOLIDATED MINING & SMELTING CO. DESIRES ORE FROM INDEPENDENT COMPANIES OF BRITISH COLUMBIA

Speaking at a banquet of the Associated Boards of Trade for Eastern British Columbia on February 23, J. J. Warren, president of the Consolidated Mining & Smelting Co., stated that his company had completely sold its stock of lead, and that the condition of the market for that metal was such that the company had commenced to enlarge its lead-refining plant from its present capacity of 90 tons per day to 150 tons; and it will handle not only its own ores, but all other ores in the territory. Mr. Warren stated further that the company was making arrangements to recover for private operators the zinc in silver-lead-zinc ores, and payment would be made for part of the metallic content of all three metals. This was only a start, and as the process was improved better terms would be given to shippers. The company has spent $3,000,000 on developing its electrolytic-zinc process and in the separation of the minerals in the Sullivan ore, and now it was going to give the benefit of this work to the independent mine-operators. In conclusion, he stated that if the operators would stop talking about what the Government should do for them and rely on themselves the Kootenay would have a prosperous mining industry. While the majority of the independent mine-operators were glad to hear this announcement from the president of the Consolidated, it has been suggested that the announcement made recently by the Bunker Hill & Sullivan company that it intended to erect an electrolytic-zinc plant and to treat custom ore may have had something to do with the new plans of the Consolidated.

ARIZONA

Douglas.—The Copper Queen and Calumet & Arizona smelters at this point now have more than 800 men on the payroll, this to be compared with 100 on the first of the year. The last payroll represented disbursement of nearly $80,000 for one-half month.

Jerome.—Steam-shovel work at the United Verde will be in ore within a few days, when a vein of low-grade quartz will be tapped.——The United Verde Extension is running one reverberatory, and is making an appreciable hole in the ore on hand. The company's annual report shows that for the four months of operation in 1921 the copper cost was 13.46c. per pound, this counting all charges, which included $95,000 for construction work at the plants at Clemenceau. In drifting toward the Jerome Verde on the 1100-ft. level and only 50 ft. from the division line, the Extension company has entered a body of copper ore said to sample 30%. There is belief that the ore will continue into Jerome Verde ground, which now is under control of the Extension.

The Verde Central has completed the station at its 650-ft. level, and is sinking its shaft, now down about 25 ft. below the station, and all in ore. A drift on the 650-ft. level is being driven in ore.

Patagonia.—A number of old mines are starting to ship following the resumption of smelting at Douglas. The Mowry, with about 50 men employed, is shipping high-grade silver-lead ore and the Morning Glory is installing electric power for active operations. The January mine, near the

World's Fair, is to resume operations at once. It is backed by Los Angeles interests.

Tombstone.—The Nordberg compressor, one of the largest in the South-West, has been started at the Bunker Hill mine power-house, furnishing air to more than 30 lessees in the Tombstone district. The fact that the Douglas smelters have re-opened, however, and will soon be in a position to take Tombstone ores, is responsible for the resumption of operation of the big compressor. Silver-lead ores will continue to be shipped to El Paso, although it is announced that the Douglas smelter may install a lead-furnace which will take care of all Tombstone and Bisbee lead ores. This will cause an added production of lead-silver ores in the Tombstone district as a consequence of lower freight-rates.

CALIFORNIA

Grass Valley.—Work has been commenced on the Bullion group controlled by capitalists at San Francisco and Salt Lake City. The Galena shaft is to be unwatered to a depth of 1500 ft. Lateral development will follow.———At the South Star mine in Dead Man Flat gold ore has been exposed in three drifts on the 100-ft. level, according to reports. Work is confined to above the water-level, but it is planned to unwater the shaft and develop a lower horizon.

Jackson.—The new hoist at the Central Eureka mine has been intalled and is ready for operation as soon as the new steel head-frame is completed. Ore at the present time is coming from sundry levels, including that at 3900 ft. The new hoist has sufficient capacity to permit work at greater depth.———It is reported that the Moore Mining Co. will sink an additional 350 ft. and install new machinery.

Redding.—Construction is proceeding at the zinc-oxide refinery of the Shasta Zinc & Copper Co. At present 75 men are employed. The mines and smelter are to be operated at capacity when the refinery is finished. The zinc oxide passing through the first furnace and bag-house will be freed from lead in the refinery and converted into a pure material for use in the manufacture of paint.———Reports are current that the United States Smelting, Refining & Mining Co. is negotiating for the Balaklala group of mines at Coram. The company owns the Mammoth mines and smelter near Kennett. The Balaklala Copper Co. has liquidated an indebtedness of $1,000,000 to the Windsor Trust Co., and all obstacles in the way of the rumored sale are rapidly being removed.

COLORADO

Aspen.—Lesees of the Highland Light in Tourtelotte Park will start shipments a soon as the roads open. Ore assaying 50 to 87 oz. silver is being mined from a three-foot vein, recently opened.———The Park Tunnel company is developing ore on its Best Friend, Jenny Lind, and Last Dollar claims, and in the Libby Bell tunnel. The ore is reported sampling 50 oz. silver and 20% lead on the Best Friend and 5% lead on the Jenny Lind. The aerial tram, under construction, extending to the railroad, will be completed by the end of March.

Black Hawk.—The new mill of the Midwest Mining & Milling Co. is operating steadily, treating from 65 to 125 tons daily, according to speed of the rod-mill. It is concentrating crude ore averaging between $10 and $20 per ton in a ratio of 15 to 1. The ore is conveyed from mine to mill by belt and it is claimed a saving of 15% is effected by local treatment as compared to paying smelting charges. The rod-mill introduced in Mexico by the Phelps Dodge company, requires but little operating attention.

Cripple Creek.—The Cresson company is again shipping from 8 to 10 cars daily to the Golden Cycle mill, while development in progress is reported to be adding steadily to reserves.—Lessees of the Doctor-Jack Pot are again producing a good grade of ore from that Raven Hill property. Two cars of ore were forwarded to the Golden Cycle mill last week.———The Modoc Consolidated Mines Co. is making lighter production while cross-cutting at the bottom or 1500-ft. level, to prospect undeveloped territory on the Combination claim of the Last Dollar group.

The Vindicator company reports progress with the Roosevelt Tunnel extension and expects to make connection by the end of March.———Three cars of ore assaying from one to two ounces gold per ton were loaded recently from the Gold Bond property on the south-western slope of Gold Hill. The ore was mined by lessees of the Cripple Creek Gold Bond Co., now controlling the property.———Lessees of the Vindicator company, Darnell and Seitz, operating at the eleventh level of the Hull City shaft, are mining ore from a 10-ft. vein, carrying streaks assaying as high as six ounces gold per ton. They are saving ore for shipment.

Eagle.—Contracts have been let to local saw-mill men for 100,000 ft. of lumber by A. Hanson of Denver, general manager of the Polar Star group in the Fulford district, to be used in the construction of mill, mine, and other buildings. Orders for mill equipment have been placed in Denver; they include a hydro-electric plant. Workmen have started laying a pipe-line from West Lake Creek to the Palor Star camp, and with weather conditions favorable the work will be pushed to completion.———Samples of the ore are reported to have shown gold content of $17.60 per ton.

Leadville.—The Denver owners of the Louisville mine, E. Hanifon and W. O. Reynolds, are planning to resume operations. Additional leases have recently been issued on the Penrose. The second unit of the Western Zinc Oxide Co.'s smelter completed two years ago, but never operated, is shortly to be started, according to current reports.

IDAHO

Coeur d'Alene.—J. M. Loney and associates have the lease below the tunnel-level of the Western Union mine. They sank a winze 50 ft., then drifted across to the orebody and broke into 3½ ft. of good ore, some of it high-grade, that will sort, hand-jig, and mill to make a fine product. Kron & Johnson raised from the tunnel about 45 ft., where they entered the orebody, which is proving valuable. Four carloads have been shipped from one stope. Returns from the first carload give more than $56 per ton. ———Two carloads of ore have been taken from the Success mine, two miles north-west of Wallace, by lessees, between the 450- and 500-ft. levels. They expect it to average more than 40 oz. silver per ton, with 30% lead.———Ore has been entered in the property of the North Bunker Hill Mining Co., according to reports. From the bottom of the 500-ft. inclined shaft a cross-cut was run north, which struck a vein. This was drifted upon east for about 300 ft., where ore was found. The vein is reported to show three feet of mill-ore.

Good ore was recently found in the Independence Lead mine; 18 to 20 ft. of mill-ore was cross-cut that is said to average 7% lead and 2½ oz. silver. The management is now driving a tunnel west of a dike that intercepted the vein. If ore is found beyond the dike the ore is probably a continuation of the You Like vein, one of the richest in the vicinity. In that event it is the intention to run a cross-cut 250 ft. from the lower tunnel to the ore.———An agreement has been entered into whereby the Rex Consolidated and the Red Monarch mines will be consolidated, according to Raymond Guyer, representing the Rex and G. I. Toevs of the Red Monarch. A strong group of Eastern capitalists will underwrite sufficient treasury stock to prospect and develop both properties. The Red Monarch tunnel will be extended 2000 ft., at the extremity of which it will have attained a depth of 1200 ft. and will have a length of 6400 ft. A raise of 200 ft. will connect the tunnel with the Rex shaft and drain all the Rex veins, thus avoiding a heavy expense for pumping. The Red Monarch tunnel will make accessible a block of ground in the Rex that is 400 ft. high, no work having been done below the 500-ft. level in the Rex. Alex Ramstedt, auditor for many of the Day mining interests in the Coeur d'Alene, was recently elected a director of the Tamarack & Custer company, taking the place of the late Eugene R. Day. The election was at the annual meeting of stockholders. Jerome J. Day was re-elected president and manager.

MICHIGAN

Houghton.—The work of getting the Calumet stamp-mill of the Calumet & Hecla in readiness for resumption of operations on April 1 is progressing. Steam has been turned on in the big plant to make working conditions more comfortable for the men engaged in making necessary repairs. The tables and other equipment have not been seriously affected by the long suspension and investigation has disclosed that needed repairs are of a minor nature. Probably not more than three heads will be put in operation on April 1 and production for the first few months will be comparatively small. Ore now being hoisted from some of the conglomerate shafts during the progress of shaft repairing will be shipped to the mill as soon as the heads are ready for it.

Eighty more shaft-repair men were put to work during the week in the conglomerate branch, in shafts 6, 7, and 8. Good progress is being made in the re-opening of No. 6 and 7. Progress is slower in No. 2 and 4 shafts, where it is necessary in certain stretches to cut away the foot-wall from one to two feet to clear and straighten out the shafts.

Water is gaining in Tamarack No. 5 shaft owing to an accident to one of the bailers, an overhoist snapping the cable and permitting the bailer with 5000 gallons of water to drop to the bottom of the shaft, a depth of nearly a mile. The bailer in its downward course ripped the shaft badly in some places, necessitating extensive repairs. An air-pump will now be installed at the bottom of the shaft to pump the water into the other undamaged compartment to be hoisted to the surface. Some of the water also will be forced into the Red Jacket shaft, from where it will be pumped to No. 4 shaft to the 49th level into a dam between No. 5 and 6 shafts, and from there through those shafts to surface.

Mayflower is continuing its east cross-cut on the 1700-ft. level in the hope of again picking up the Mayflower vein. The cross-cut has been in trap for a long stretch, but there apparently is every reasonable assurance that the lode will again be cut.

Copper shipments out of the district have shown a considerable increase of late. Calumet & Hecla in particular has been sending out from one to two carloads per day for the last two weeks. A considerable part of this metal, it is understood, is for export.

MINNESOTA

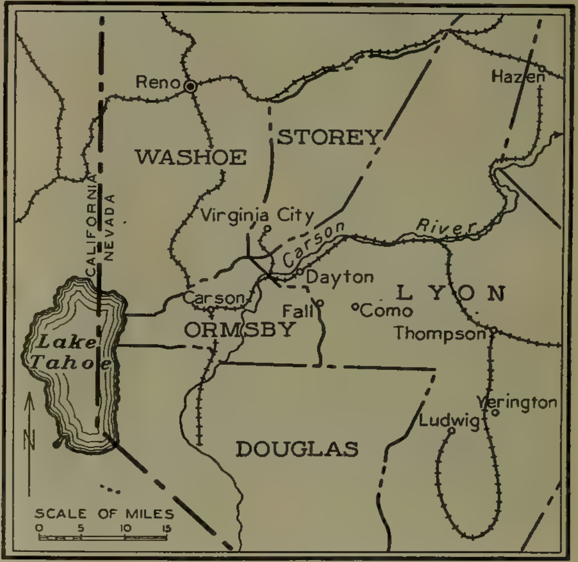
Hibbing.—At a meeting of the Minnesota Alumni of the Michigan College of Mines, held Wednesday, February 22, a permanent organization was formed. The following officers were elected: president, W. R. Van Slyke, Eveleth; vice-president, W. A. McCurdy, Virginia; secretary-treasurer, J. A. MacKillican, Hibbing. Resolutions were adopted whereby the Minnesota Alumni endorsed the idea of Donald B. Gillies, president of the M. C. M. Alumni, in making a survey of conditions at the college with recommendations for any improvements.

MONTANA

Elkhorn.—Between 250 and 300 tons of ore is being concentrated daily at the mill of the Boston & Montana Development Co., according to John D. Pope, general manager. A recovery of 93% is being obtained in the flotation plant, this being an improvement over earlier results. Copper concentrate containing 3% copper, 30 oz. silver, and $2.80 in gold is being shipped to the Tacoma smelter of the American Smelting & Refining Co. A lead concentrate is also made that assays 65 oz. of silver and 45% lead. It is proposed to increase the tonnage to 400 per day.

NEVADA

Argentite.—The 200-ft. shaft of the Frances and 300 ft. of drifts on the 100-ft. level are in ore of an average value of $25 to $28, according to F. H. Taylor, manager of the mine. For a length of 300 ft. and to a depth of 200 neither break nor barren zone has been found in the ore-shoot, Taylor says. The company employs 18 men and machine-drills are used. Work on the 100-ft. level has been discontinued and drifting and cross-cutting on the 200-ft. level has been started. The shoot is 300 ft. long, according to Taylor; and a cross-cut will be driven through it. The shaft is on the foot-wall of the vein, a quartz- and barite-filled fissure with andesite as the foot-wall and rhyolite as the hanging. The principal content of the ore is argentite, with a small quantity of gold, and as much as 15% in sulphide form in some examples. The average barium content is 3 to 4% and the ore also contains a great deal of manganese. Two lessees on the Frances are in ore, one in a 200-ft. tunnel and the other in a 70-ft. shaft. The tunnel is in low-grade ore, but in the shaft there is a 12-in. width of $200, and a 3-ft. width of $25 ore. Argentite is at an elevation of 7500 ft. in the Silver Peak range, north-west of Goldfield. The Frances is being operated by the Wattersons of Inyo county, California.——A 200-ft. shaft has been sunk on the Ecklund group, one mile south-east of the Frances.



West-Central Portion of Nevada

Lovelock.—Neuhaus & Valcart, lessees on the Montezuma claim in the Arabian district, have opened a 5-in. vein of lead-silver ore from which assays of 300 oz. silver and 28% lead have been obtained. They are now drifting on the vein.——A. Knapp, who has been working a block of ground under lease on the Electric group on the Last Chance vein, has shipped two carloads of $50 ore, and will soon ship the third car. This vein crosses the Montezuma claims.

Mina.—According to P. A. Simon, manager for the Simon Silver-Lead Mines Co., the new flotation plant is making an excellent grade of lead concentrate, assaying from 58 to 60% lead and 38 to 40 oz. of silver. Severe weather has seriously handicapped operations and the mill has not come up to expectation in the matter of capacity. This, however, will be remedied shortly. The manufacture of paint pigments at Harbor City, California, has proved successful. Additional equipment has been ordered to enable the plant to handle the entire output of zinc concentrate from the mine at Mina.

Reno.—The Nevada Copper Belt Railroad Co. has filed reduced rates on all ore exceeding $10 per ton in value from all points on its road to Wabuska, according to announcement made today by the public service commission. The action of the railroad was taken in response to recommendations made last November when the public service commission called a conference to work out adjustments in ore-rates. From Hudson to Wabuska the rate formerly graded from $2.50 per ton for $100 ore to $4 per ton for $300 ore; now all these grades carry the $2.50 rate for ore in excess of $300, only 2% is added, in place of 4% formerly in effect. From Yerington to Wabuska the rate of $100 ore was $1.30 and on $300 ore it was $2.50, whereas now all ore from $100 to $300 value carries the $1.30 per ton rate.

Virginia City.—Construction work on the 2500-ton mill of the United Comstock company, delayed by bad weather, has been resumed. The plant is expected to be completed by November 1. Development of the new veins exposed in the long drainage and transportation tunnel will be started.

UTAH

Bingham.—The Utah Consolidated Mining Co. and the Utah-Apex Mining Co. have restored the scale of wages that was in effect prior to January 16, 1922. On that date, wages were cut 50c. per shift at all underground mines in Utah, but as there has been considerable dissatisfaction and trouble at some of the silver-lead properties, all mines, except the Utah Copper, have gone back to the scale in effect at the first of the year. Machine-men now receive $4.25, the same as at Butte, while shovelers receive $3.75.

Eureka.—The State Industrial Commission has denied compensation, under the Utah Workmen's Compensation Act, to Mrs. Elizabeth Westerdahl, widow of John Westerdahl, former superintendent of the Tintic Standard mine, who was killed in a hold-up at the company's store on March 9, 1921. The Commission holds that Westerdahl was not killed in the course of employment, and that the widow and daughter are not entitled to compensation.

Conditions at the North Standard property are promising, according to Charles F. Wilcox, president. Recently a 2½-ft. orebody was opened, showing average assays of 60c. gold, 28.4 oz. silver, and 35 to 40% iron. The ore is high in iron oxide, and is therefore desired by smelters for fluxing. Development has been in progress at the North Standard for some time past on the 500-ft. and 1100-ft. levels. The new orebody was found on the 1100-ft. level.

Ore shipments for the week ending February 25 totaled 131 carloads, as compared with 148 cars for the previous week. The Tintic Standard shipped 41 cars; Chief Consolidated, 40; Iron Blossom, 13; Grand Central, 8; Eagle & Blue Bell, 6; Swansea, 6; Victoria, 5; Colorado, 4; Centennial-Eureka, 3; Gemini, 2; Mammoth, 1; Bullion-Beck, 1; Empire, 1.

Park City.—The Judge Mining & Smelting Co. shipped 17,259 tons of ore during 1921, the gross value of which was $582,606, with a net return of $19,927. The value of improvements, machinery, etc., is given as $299,080. The Daly Mining Co. shipped 903 tons of ore, valued at $37,752, while operating expenses totaled $47,168, resulting in a deficit of $9416. The Daly-West Mining Co. shipped 7510 tons, with a gross yield of $233,019. Expenses totaled $319,800, leaving a deficit of $86,781.

Ore shipments for the week ending February 25 were the largest reported for the present year, a total of 2814 tons being shipped, as against 2662 tons for the preceding week. The Judge allied companies shipped 1555 tons; Silver King Coalition, 735; Ontario, 524.

Salt Lake City.—Local coal-mining companies are giving attention to the termination of contracts between the companies and the miners on April 1. While most of the Utah coal 'camps' are not unionized, wage-scales, until a recent date, followed the national scale set up by the President's Commission. Recently, three or four of the Utah coal-mining companies have reduced wages from 20 to 30%. The largest operators in the State—including the Utah Fuel Co.—have made no changes, and it is reported that none will be made until April 1. While reports from Eastern coalfields indicate that the employees will oppose a reduction in wages for bituminous miners and ask for an increase for the workers in anthracite fields, the local opinion is that a reduction will be made by all Utah operators when the present contracts expire.

WISCONSIN

Platteville.—The past month in the local zinc mines was disappointing. Many operators who had determined on an early resumption of operations and ore production postponed action. The price of zinc ore, which has been maintained locally for some time at $30 per ton, base, 60% zinc, dropped during the month. This compelled separating plants purchasing crude zinc concentrate in the open market to submit lower offerings, and shippers withdrew from the market, although some continued to make a regular production, which was piled up at mines; some shipped to the separating plant, where the ore was utilized in the manufacture of sulphuric acid, while the high-grade residue was allowed to pile up at storage quarters at the separating plant.

The price of lead ore was well maintained through the month and shipments from the several mining camps in the district were fairly regular all month, the principal buyers being the Federal Lead Co. A slight gain was made on offerings, the base price advancing mid-month from $60 per ton, at which figure the market had been set for some time, to $63 per ton, base, 80% metal content. On this base high-grade milled lead concentrate came within a fraction of reaching $65 per ton. With the metal market uniform it was difficult for producers to understand the advance, but the information was given out that stocks of ore at smelters were running low and that supplies were becoming imperative. This steady gain in prices, with a constant and consistent demand, has encouraged prospecting for lead-ore deposits, while at mines in operation, where lead ore is obtainable, more attention is being given to increase production.

Producers of carbonate-zinc ore, operating in the northern part of the district, received definite offers for their ore. On the higher grades the prices submitted were of a tempting nature and some deals were made, but bad weather precluded the making of shipments. Deliveries will be made early in March.

Zinc producers reported that while business in slab zinc was slow, sales of pigment were satisfactory. Domestic zinc-oxide makers are under less handicap from French and British competition now than some months ago, due to the relatively higher prices on foreign pigments resulting from the higher quotations on slabs.

High-grade 66°B. sulphuric acid was quoted at $17 to $18 per ton, f.o.b. maker's works. The National Zinc Separating Co., at Cuba City, was engaged in shipping regularly and supplies affording base for manufacture were received at the works in fair volume until the price of low-grade zinc concentrate fell, and rainy weather made shipping difficult. The capacity of the plant will be increased this spring.

BRITISH COLUMBIA

Rossland.—The lessees of the I. X. L. mine recently shipped another car of bonanza ore to the Bunker Hill & Sullivan smelter; the ore is said to run about $7000 per ton. It is reported that the lessees of the I. X. L. have taken a lease on the O. K. mine, from which several pockets of bonanza ore have been taken in the past.

Stewart.—The mineral exhibit from this district that was shown at the American Mining Congress, at Chicago, has been forwarded to London for exhibition purposes.——The Premier tramway is delivering ore to the bunkers faster than it has been possible to get it shipped to Tacoma. Recently the steamers 'Tartar', 'Amur', and 'Anyox' left here with all available space taken by Premier ore.

Trail.—The Consolidated M. & S. Co. has commenced the construction of a new electrolytic-zinc plant that will be used only for custom ore. The bulk of the zinc concentrate from the Slocan district runs high in silver, whereas the silver content of the Sullivan ore is low; for this reason and because it was thought advisable not to check the even running of the main plant by the treatment of custom ore of a different zinc content from that of the Sullivan ore this new and smaller plant is being built.

Reduction Plant of the Mining Corporation of Canada, at Cobalt, Ontario

MEXICO

Mexico City.—It is expected that with the revival of gold, silver, copper, and lead mining in Mexico, such as is now indicated by reports received from various mining districts the production of these metals will show a large increase this year over that of 1921. According to a statement just issued by the Department of Commerce and Industry of the Mexican government there was exported from this country in 1920 a total of 22,864 kg., equivalent to 49,024 lb. of gold, and in 1921 a total of 21,257 kg. of the metal. The gold exports in 1920 amounted to ₱30,500,000, as compared with ₱28,000,366 in 1921.

In 1921 around 2,068,398 kg. of silver was exported, as compared in 1920 with about 2,005,143 kg.; the respective values were $136,508,528 and $82,214,490.

It is pointed out in the official statement that the production of minerals still leads all other industries of the country with a total export value of ₱241,000,000 for the year 1921. Oil comes second with a total export value of ₱145,508,949 for that year.

ONTARIO

Cobalt.—A group of shareholders of the La Rose, who are dissatisfied with the management, some time since appointed a committee consisting of W. S. Andrews, John B. Spurr, and A. A. Challener with a view to securing a new board of directors. This committee has circularized the 4700 shareholders asking for proxies for the annual meeting on March 31. The committee asks the co-operation of the shareholders on the ground that the mine should be more economically managed, mining costs having been too high, and that no attempt is being made to treat low-grade ores, which, if properly handled, would yield large profits.

Kirkland Lake.—The first annual report of the Wright-Hargreaves since operations were begun shows a net profit of $201,186 for the eight months ending December 31. Bullion was produced to the value of $408,665 from the treatment of 36,081 tons of ore which came almost entirely from development work. The broken ore on hand on December 31 amounted to 25,085 tons.

The shaft on the Sylvanite is down 300 ft., at which point it is planned to carry on lateral operations.

At the annual meeting of the Tough-Oakes on February 22 it was announced that the mill probably would be in operation in April, and that the No. 2 vein, from which valuable ore had been extracted and which had faulted, had been picked up on the Burnside property, where it showed increasing richness.

Porcupine.—The annual statement of the Hollinger Consolidated for 1921 shows the largest production of gold and the highest rate of earnings in its history. Income from production was $10,031,050, and from investments $283,464, making a total of $10,314,515, as compared with $7,162,611 in 1920. Operating charges were $5,222,855, leaving operating profits of $5,091,659. The net profit after deducting for taxes and depreciation was $4,026,927, as compared with $2,675,274 for the previous year. The company paid dividends of $3,198,000, after which $828,927 was added to the surplus, which now stands at $3,960,779. The ore-reserves were valued at $36,644,154, being a slight increase. The number of tons milled during the year was 1,072,493, of the average value of $9.67 per ton.

The shareholders of the McIntyre-Porcupine on February 23 authorized the changing of the par value of the stock from $1 to $5. It was announced to the shareholders that negotiations were in progress for the sale of the treasury stock to New York capitalists.

The Nipissing is continuing diamond-drill operations on the Rochester, where eight holes have been put down and another is under way.

YUKON TERRITORY

George P. Mackenzie, Gold Commissioner for the Yukon, has issued his annual review of mining operations for 1921. He says that the summer of 1921 was an exceptionally dry one, and the consequent shortage of water reduced the output of gold from hydraulic mining. Notwithstanding this, however, the gold output for the year will be in excess of that of 1920. At least three new placer discoveries of importance were made during the year. The result of Keystone drilling on Russel creek, a tributary of McMillan river, has been so satisfactory that the parties interested have arranged for further development to be done next season. New ground has been opened on Miller river. Rich pay-ground has been discovered, also, on Allgold creek.

Extensive development was done during the year on the silver-lead properties in the Mayo district. During the winter of 1920-21 the Keno Hill, Ltd., mined and hauled to Mayo more than 2300 tons of high-grade ore that was shipped to the smelter during the summer. The company has increased its holdings, has employed a large force of men during the summer on development, and will ship during the present winter a larger tonnage than was shipped last year. F. W. Bradley has acquired extensive holdings in the district, has erected permanent and substantial buildings, and has a large force of men developing his property.

What promises to be the most important discovery of all was demonstrated after Mr. Mackenze's visit to the Mayo district. David Cunningham and Ray Stewart opened a strong lode on the Ladue claim, on Keno Hill; later a buckboard accidentally exposed a piece of float on the Friendship claim, half a mile away, and Joel Sunderland exposed the lode in an open-cut; since then, a series of open-cuts have demonstrated the course of the lode, known as the McQuesten Slope silver-vein, for nearly a mile in length. The vein varies from 5 to 15 ft. in thickness, and carries from 200 to 500 oz. of silver per ton and from 30 to 60% lead. The persistence of the vein on the surface, together with the persistence of the other veins on Keno Hill for such depths as have been attained—about 300 ft.—suggests the persistence of the McQuesten Slope vein. A year ago any of the claims on which this vein has been found might have been purchased for $200; today all the claims are bonded at figures ranging from $40,000 to $65,000 each.

Obituary

Earl W. Hulse, of Salt Lake City, died at Pekin, China, on February 28. Accompanied by his wife he sailed from San Francisco in January for the Orient, and later intended to visit Europe. He had been identified with the mining industry in Utah and Nevada for many years, and was particularly interested in the development of mines in the Alta district. He was a native of Rochester, Indiana, and was 38 years of age.

John Casper Branner, at one time Professor of Geology and later President of Stanford University, died at Palo Alto, California, on March 1 after a protracted illness, at the age of 71. He was born in Tennessee and was educated at Cornell University. In 1875 he went to Brazil and began a long and honorable connection with the geology of that country, on which he wrote a textbook in Portuguese. In 1887 he was appointed State Geologist of Arkansas, and in 1892, when Stanford University came into existence, he became Professor of Geology. From 1913 to 1915 he was President of the University; in 1916 he retired with the title of President Emeritus. As professor and as head of the university he was respected and beloved by the students, many of whom were his personal friends—among them, Herbert Hoover and many other distinguished mining engineers.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

R. C. Gemmell is spending a few weeks in New York.

W. E. Thorne was in San Francisco this week, from Santa Cruz.

L. A. Walker has moved from Gilmore, Idaho, to Salt Lake City, Utah.

H. S. Munroe, general manager for the Granby company, is at Los Angeles.

Eugene A. H. Tays, of San Blas, Sinaloa, Mexico, was in San Francisco this week.

Harry J. Phillips has returned to Seattle, Washington, from Anchorage, Alaska.

Robert Clarke, of Denver, Colorado, is at Gottville, in Siskiyou county, California.

H. R. Robbins has joined the technical staff of the American Cyanamid Co., in New York.

W. L. Lanagan, Major, Engineer Corps U. S. Army, is here on a visit from Washington.

J. E. Spurr, editor of the 'Journal-Press', has returned from San Francisco to New York.

J. A. Agnew has been elected a director of the Consolidated Gold Fields of South Africa.

Louis S. Cates and **D. D. Moffat** are visiting the Ray Consolidated Copper Co.'s properties in Arizona.

R. I. Green has joined the field staff of the Utah Department of the American Smelting & Refining Co.

D. W. Brunton sailed from San Francisco for Tahiti on March 3; he expects to remain there one month.

G. A. Swanquist, of Canon City, Colorado, has gone to Mineral Hormiguero, El Salvador, Central America.

P. H. Reagan, who has been at San Antonia, Baja California, Mexico, for some time, is at Big Spring, Texas.

C. F. Kelley, **B. B. Thayer**, and **John Gillie**, of the Anaconda Mining Co., spent several days in Utah recently.

Duncan MacVichie, president of the Western Utah Copper Mining Co. at Salt Lake City, is in California on a holiday.

Walter L. Reid, consulting metallurgist to the United Comstock Mines Co., was here this week from Virginia City, Nevada.

Bradley Stoughton was elected president of the Yale Engineering Association at the annual meeting held on February 2.

William Wraith, general manager for the International Smelting company, spent a few days at Salt Lake City on business.

Herbert Hoover, Secretary of Commerce, will attend the Colorado River Conference at Phoenix, Arizona, on March 15 and 16.

H. B. Tooker, traffic manager for the Jackling copper companies, has returned to San Francisco from an extended trip in the East.

Frank H. Sistermans has returned to New York after seven months' absence in Mexico examining mines in different parts of that country.

John C. Greenway, general manager for the Calumet & Arizona Mining Co., has been commissioned a brigadier-general in the U. S. Reserve Corps.

J. D. MacKenzie, superintendent of the Vancouver branch office of the Canadian Geological Survey, is in Ottawa, making arrangements for the coming season's field-work in the Province.

C. H. Eldridge, formerly associated with C. G. Fink in the development of the insoluble anode used at Chuquicamata, is now on the staff of the Bureau of Mines at Pittsburgh.

THE METAL MARKET

METAL PRICES

San Francisco, March 7

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	13—14
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$90
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6—7
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

March 6.—Copper is quiet and stronger. Lead is steady and firm. Zinc is more active and higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Feb.	28	62.75	32.12½	Jan.	23	65.27	34.90
Mch.	1	63.62½	32.37½	"	30	65.46	35.06
"	2	63.00	32.12½	Feb.	6	66.35	35.00
"	3	64.25	32.87½	"	13	65.75	34.22
"	4	63.75	33.00	"	20	65.44	34.23
"	5 Sunday			"	27	64.00	32.92
"	6	63.25	32.62½	Mch.	6	63.44	32.52

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	132.77	65.95	65.45	July	92.04	59.99	....
Feb.	131.27	59.55	65.28	Aug.	96.23	61.59	....
Mch.	125.70	56.08	....	Sept.	93.66	66.22	....
Apr.	119.56	59.33	....	Oct.	83.48	71.00	....
May	102.69	59.90	....	Nov.	77.73	68.24	....
June	90.84	58.51	....	Dec.	64.78	65.76	....

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Feb.	28	12.50	Jan.	23	13.54
Mch.	1	12.50	"	30	13.48
"	2	12.62½	Feb.	6	13.29
"	3	12.62½	"	13	13.17
"	4	12.62½	"	20	12.88
"	5 Sunday		"	27	12.60
"	6	16.62½	Mch.	6	12.58

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	19.25	12.94	13.54	July	19.00	12.46	....
Feb.	19.05	12.84	12.95	Aug.	19.00	11.71	....
Mch.	18.49	12.20	....	Sept.	18.75	12.03	....
Apr.	19.23	12.50	....	Oct.	16.53	12.66	....
May	19.05	12.74	....	Nov.	14.63	13.07	....
June	19.00	12.83	....	Dec.	13.18	13.54	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Feb.	28	4.70	Jan.	23	4.70
Mch.	1	4.70	"	30	4.70
"	2	4.70	Feb.	6	4.70
"	3	4.70	"	13	4.70
"	4	4.70	"	20	4.70
"	5 Sunday		"	27	4.70
"	6	4.70	"	6	4.70

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	8.65	4.96	4.70	July	8.63	4.75	....
Feb.	8.88	4.54	4.70	Aug.	9.03	4.40	....
Mch.	9.22	4.06	....	Sept.	8.08	4.61	....
Apr.	8.78	4.32	....	Oct.	7.28	4.70	....
May	8.55	5.01	....	Nov.	6.37	4.70	....
June	8.43	4.57	....	Dec.	4.76	4.70	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	62.74	35.94	32.04	July	49.29	27.69	....
Feb.	59.87	32.16	30.74	Aug.	47.60	26.35	....
Mch.	61.92	28.87	....	Sept.	44.43	26.70	....
Apr.	62.17	30.36	....	Oct.	40.47	27.70	....
May	54.99	32.50	....	Nov.	36.97	28.93	....
June	48.33	29.39	....	Dec.	34.12	32.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Feb.	28	4.90	Jan.	23	5.04
Mch.	1	4.90	"	30	4.93
"	2	4.90	Feb.	6	4.85
"	3	4.95	"	13	4.84
"	4	4.95	"	20	4.85
"	5 Sunday		"	27	4.85
"	6	4.97½	Mch.	6	4.93

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	9.56	5.86	5.05	July	8.18	4.41	....
Feb.	9.15	5.34	4.85	Aug.	8.31	4.69	....
Mch.	8.93	5.19	....	Sept.	7.84	4.74	....
Apr.	8.76	5.37	....	Oct.	7.50	5.09	....
May	8.07	5.37	....	Nov.	6.78	5.18	....
June	7.92	4.96	....	Dec.	6.03	5.24	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Feb.	7	50.00	Feb.	21	50.00
"	14	50.00	"	28	50.00
			Mch.	7	50.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	89.00	50.00	50.00	July	88.00	47.75	....
Feb.	81.00	48.75	50.00	Aug.	85.00	47.50	....
Mch.	87.00	45.88	....	Sept.	75.00	47.50	....
Apr.	100.00	46.00	....	Oct.	71.00	46.25	....
May	87.00	50.00	....	Nov.	56.00	40.40	....
June	85.00	49.50	....	Dec.	52.50	49.50	....

"UNREASONABLE ACCUMULATION OF PROFIT" DEFINED

One of the provisions of the present income-tax law concerning which keen interest has been manifested is section 220. This section, it will be recalled, imposes an additional income tax of 25% upon any corporation found to have permitted an unreasonable accumulation of its profits for the purpose of preventing the imposition of the surtax upon such income if distributed to its stockholders. 'Income Tax Regulations 62', which has just been issued by the Treasury Department, throws some light upon what constitutes an "unreasonable accumulation of profits". Article 353 of these regulations says:

"An accumulation of gains and profits is unreasonable if it is not required for the purposes of the business, considering all the circumstances of the case. No attempt can be made to enumerate all the ways in which gains and profits of a corporation may be accumulated for the reasonable needs of the business. Undistributed income is properly accumulated if invested in increased inventories or additions to plant reasonably needed by the business. It is properly accumulated if retained for working capital required by the business or in accordance with contract obligations placed to the credit of a sinking-fund for the purpose of retiring bonds issued by the corporation. . ."

Article 352 of the same regulations, under the heading 'Purpose to Escape Surtax', says:

"Section 220 of the statute applies where a corporation is formed or availed of for the purpose of preventing the imposition of the surtax upon its stockholders or members by permitting its gains and profits to accumulate instead of being divided or distributed. Prima-facie evidence of a purpose to escape the surtax exists where a corporation has practically no business except holding stocks, securities, or other property and collecting the income therefrom or where a corporation other than a mere holding company permits its gains and profits to accumulate beyond the reasonable needs of the business.

"The business of a corporation is not limited to that which it has previously carried on, but in general includes any line of business which it may legitimately undertake. However, a radical change of business when a considerable surplus has been accumulated may afford evidence of a purpose to escape the surtax. When one corporation owns the stock of another corporation in the same or a related line of business and in effect operates the other corporation, the business of the latter may be considered in substance the business of the first corporation. Gains and profits of the first corporation put into the second through the purchase of stock or otherwise may therefore, if a subsidiary relationship is established, constitute employment of the income in its own business.

"To establish that the business of one corporation can be regarded as including the business of another, it is ordinarily essential that the first corporation own substantially all of the stock of the second. Investment by a corporation of its income in stock and securities of another corporation is not without anything further to be regarded as employment of the income in its business."

MONEY AND EXCHANGE

Foreign quotations on March 7 are as follows:

Sterling, dollars:	Cable	4.40
	Demand	4.39¾
Franc, cents:	Cable	9.00
	Demand	9.08
Lira, cents:	Demand	5.17
Mark, cent:		0.42

Eastern Metal Market

New York, March 1.

A more optimistic tone pervades all the markets that have been stagnant lately.

Inquiry for copper shows some improvement and bottom prices are believed to have been touched.

The tin market has been dull except on one day, but prices have advanced.

The steady consumption and buying of lead has continued.

More optimism prevails in the zinc market and prices tend higher.

IRON AND STEEL

Further expansion of steel-making activities marked the last days of February, says 'The Iron Age'. The gradual increase in production has been larger than tonnage sales would have indicated, and shows how pressing are the necessities of the stock-bare consumers. The increase of bookings has been accompanied by fresh weaknesses in price. The resultant unsettlement is thus still holding back a large volume awaiting price stabilization. March opens at a 55% rate of steel-making for the whole country. There is practically no contracting for future needs; there is little extension of delivery dates, and business is chiefly for prompt shipment, about the only buying for second-quarter needs being in sheets and in pig-iron.

COPPER

Some sellers report a better inquiry and take a more cheerful view of the future. Actual sales have not been heavy, although they have improved, but consumers are regarded as gradually coming to the conclusion that the bottom has been reached. Sellers feel this should mean better buying later. Electrolytic copper for early or March delivery is quoted at 13.25c., refinery or New York, or 13.50c., delivered, for a moderate quantity, with most sellers quoting 13.62½c., refinery, or 13.87½c., delivered, as the more general price of those participating. There are still some large producers out of the market. An improvement in sales for export is also reported.

TIN

Heavy sales on Tuesday, February 21, came as a result of the break in the London market on the day before, February 20, and also on February 21, when the low point was reached. The sales on February 21 are estimated to have totaled 1000 tons of Straits tin and were so heavy that sellers here could not cover themselves on that day and were obliged to do business on the holiday, February 22, when several hundred tons was sold. In both cases dealers and consumers were buyers. Since those days the market has been dull and devoid of feature, but prices have advanced from a low of 29.25c. for spot Straits, New York, on February 21, to 30.75c. on Monday, February 27, receding to 29.75c. yesterday. Arrivals thus far this month have been 3270 tons with 7450 tons reported afloat.

LEAD

There is no change in the market. The broad healthy movement continues and consumption is fully equal to production. Prices are steady and firm at 4.70c., New York and St. Louis, asked by the leading interest, and 4.40c., St. Louis, or 4.70 to 4.75c., New York and Eastern points, quoted by the independents. There is no reason for prices to advance or decline.

ZINC

Due to better inquiry yesterday and Monday the market has a more cheerful tone. Prices are stiffer also, owing to this better demand and to the firm attitude of producers. Prime Western for early or March delivery is quoted at 4.55c., St. Louis, or 4.90c., New York, with some sellers asking or predicting 4.60c., St. Louis. Sales were made on Monday at 4.50 to 4.55c., St. Louis, and some yesterday at 4.55 to 4.60c. The advance in sterling has also increased the possibility of exports to England, although any decided advance here would offset this tendency. Inquiries for sales to England have been made on a basis of 4.50c., St. Louis.

ANTIMONY

Due to heavy arrivals stocks continue ample and the market is easier with wholesale lots for early delivery quoted at 4.35c., New York, duty paid.

ALUMINUM

Conditions and quotations are unchanged. The leading interest continues to quote virgin metal, 98 to 99% pure at 19 to 19.10c. per lb., f.o.b. plant, in wholesale lots for early delivery; the same grade, produced abroad, is available from importers at 17 to 18c., New York, duty paid.

ORES

Tungsten: Inquiry is broadening but buyers and sellers are too far apart to come to real business. Quotations are nominal at about $2 per unit and upward, depending on the grade and quantity.

Molybdenum: There is no change and quotations are nominal at 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: There is no interest from consumers and quotations are nominal at 25 to 26c. per unit, seaboard.

Chrome: A better inquiry is reported but quotations are nominal at $19.50 and higher, per ton, c.i.f. Atlantic ports.

FERRO-ALLOYS

Ferro-manganese: Sales of both British and American alloys are confined to carload lots at a basis of $62.50, seaboard. There is an inquiry for 500 tons in the market.

Spiegeleisen: This alloy is scarce in all grades, the 20% being exhausted and the lower grades not plentiful. Orders recently have been in sufficient volume so that one furnace at least will be started in March on the alloy. The 16 to 19% alloy is selling at $30, furnace, for early delivery.

Ferro-tungsten: There is no activity and prices are nominal at 45 to 50c. per pound of contained tungsten in domestic alloy with the foreign probably competing with this.

Ferro-chromium: No developments in new inquiry or sales are reported and prices are unchanged at 12 to 14c. per pound of contained chromium, delivered.

Approximate stabilization of automobile prices is believed in the industry to have been definitely reached, according to the 'Guaranty Survey'. The average price of 49 of the principal standard touring-car models is now 22% below the average price on September 1, 1920, but the price of the greater quantity of cars sold represents a much greater reduction. This reduction has been brought about by a series of cuts spread over more than a year, so that we now stand at what appears to be the end of the period of price revision. In view of known improvements and refinements in the product, no comparison of present prices with those of 1913 is possible or significant. At least six manufacturers have raised their prices since the first of the year, and there is justification for the belief in an apparent stabilization of the cost of the chief materials entering into motor-car manufacture.

Book Reviews

The American Language. By H. L. Mencken. 500 pp. Published by Alfred A. Knopf, New York. Price, $6.

H. L. Mencken, part owner-and-editor of the 'Smart Set' magazine, and an American literary critic of note, has written a book called 'The American Language'. The first edition appeared in 1919; a second edition now available has been revised and enlarged to a volume of 500 pages. This is an important and thorough work, and deserves wide attention.

An American dialect of the English language was predicted by Thomas Jefferson; he said that "the new circumstances . . . call for new words, new phrases, and for the transfer of old words to new objects". Even before his time new words had come into the language spoken in America: from the Indians such words as opossum, moose, skunk, squash, chipmunk, pecan, and persimmon; from the French such words as portage, chowder, cache, bureau, gopher, bogus, and prairie; from the Dutch such words as caboose, cruller, cold-slaw, stoop, span (of horses), pit (as in peach-pit), waffle, scow, boss, and Santa Claus. Later, such Spanish words came in as creole, palmetto, key (a small island), quadroon, octaroon, pickaninny, and stampede. The Pennsylvania Germans contributed sauerkraut and noodle. The negro slaves brought in gumbo, goober, and voodoo (corrupted to hoodoo). Among meanings altered in America were squab, pond, creek, lot (for a parcel of land), barn, freshet, corn, shoe, store, shop, lumber, pie, dry-goods, cracker, partridge, and haul. New combinations arose, such as wild-cat (adjective applying to speculations, frequently mining speculations), cloud-burst, square meal, horse-sense, buzz-saw, chain-gang, shot-gun, and mass-meeting. Old English such as deck (of cards), gulch, and gully. New words were invented: buncombe, greaser, campus, bloomer, blizzard, bugaboo, and maverick.

The author traces carefully, with full references, hundreds of American words; he likewise traces many changes in pronunciation and spelling. In spelling, the influence of Noah Webster, the great American lexicographer, had a tremendous effect. Of Webster's 'American Spelling Book', first published in 1873, there were sold 62,000,000 copies down to 1889. Webster, with true Yankee independence, declared for simpler spellings than Dr. Samuel Johnson had favored in his pompous dictionary. Webster's great 'American Dictionary of the English Language' appeared in 1828. Some of his reforms included: deleting the 'u' in words like labour and honour; clipping the 'k' from frolick, physick, and their analogues; transposing the 'e' and 'r' in such words as centre and calibre, and changing the 'c' to 's' in words like defence. Many of Webster's attempted reforms did not take root, and were not accepted. For example, he clipped the final 'e' from determine and requisite; removed the silent 'a' from thread, feather, and steady, the silent 'b' in thumb, the 's' in island, the 'o' in leopard; changed 'ph' to 'f' in words like phantom, 'ou' to 'oo' in words like group, and 'ow' to 'ou' in crowd; and he advocated tung for tongue, and wimmen for women.

The upshot of Mencken's history of the American dialect and his interesting inquiry into the psychology of Americanisms is the suggestion that our school-teachers should improve their manner of teaching grammar. Such teaching has long been too pedantic and esoteric. Says Mencken: "Such grammar, so-called, as is taught in our schools and colleges, is a grammar standing four-legged upon the theorizings and false inferences of English Latinists of a past generation, eager only to break the wild tongue of Shakespeare to a rule; and its frank aim is to create in us a high respect for a book language which few of us ever actually speak and not many of us even learn to write. That language, elaborately artificial though it may be, undoubtedly has merits. It shows a sonority and a stateliness that you must go to the Latin of the Golden Age to match; its 'highly charged and heavily-shotted' periods, in Matthew Arnold's phrase, serve admirably the obscurantist purposes of American pedagogy and of English parliamentary oratory and leader-writing . . . But to the average American, bent upon expressing his ideas, not stupendously but merely clearly, it must always remain something vague and remote, like Greek history or the properties of the parabola, for he never speaks it or hears it spoken, and seldom encounters it in his everyday reading . . . This fact, I dare say, is largely responsible for the notorious failure of our schools and colleges to turn out pupils who can put their ideas into words with simplicity and intelligibility . . . No attempt to deduce the principles of vulgar American grammar from the everyday speech of the people has ever been made by an American philologist . . . No professor, so far as I know, has ever deigned to give the same sober attention to the 'sermo plebius' of his country that his colleagues habitually give to the pronunciation of Latin, or to the irregular verbs in French."

Mencken, literary aristocrat though he is, is profoundly interested in the speech of the so-called man in the street. "Go into any part of the country, North, East, South, or West, and you will find multitudes of his brothers, car-conductors in Philadelphia, immigrants of the second generation in the East Side of New York, iron-workers in the Pittsburgh region, corner grocers in St. Louis, holders of petty political jobs in Atlanta and New Orleans, small farmers in Kansas or Kentucky, house carpenters in Ohio, tinners and plumbers in Chicago—genuine Americans all, bawling patriots, hot for the home team, marchers in parades, readers of the yellow newspapers, fathers of families, sheep on election day, undistinguished norms of the 'Homo Americanus'. Such typical Americans, after a fashion, know English. They read it—all save the 'hard' words, i. e., all save about 90% of the words of Greek and Latin origin. They can understand perhaps two-thirds of it as it comes from the lips of a political orator or clergyman. They have a feeling that it is, in some recondite sense, superior to the common speech of their kind. They recognize a fluent command of it as the salient mark of a 'smart' and 'educated' man, one with 'the gift of gab'. But they themselves never speak it or try to speak it, nor do they look with approbation on efforts in that direction by their fellows. In no other way, indeed, is the failure of popular education made more vividly manifest."

The American people should send Mencken a vote of thanks for the insight and criticism, for the labor and scholarship, evident in this book.—P. B. McDonald.

Airplane Engine. By L. S. Marks. 454 pp., ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $6.

This book, by the professor of mechanical engineering at Harvard, formulates existing knowledge of the functioning of the airplane engine and its auxiliaries; it discusses the essential constructive details of those engines whose fitness has resulted in their survival as machines of definite value. It will be of interest to all who are in any way interested in the development of the internal combustion engine.

Mineral Resources of the United States, 1918. G. F. Loughlin, geologist in charge, Division of Mineral Resources; **Part II, Nonmetals**; R. W. Stone geologist in charge. U. S. Geological Survey, 1921. 1557 pp., 16 pl., 3 inserts. Available for free distribution to members of the mineral industry whose request shows co-operative relations with the Geological Survey. Others should apply to Superintendent of Documents, Government Printing Office, Washington, D. C. Price, $1.

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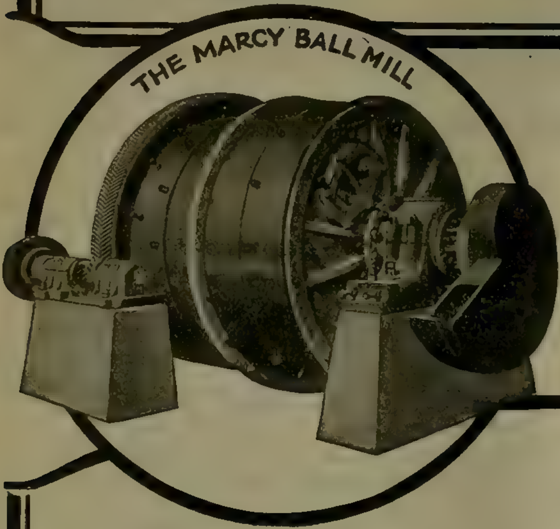

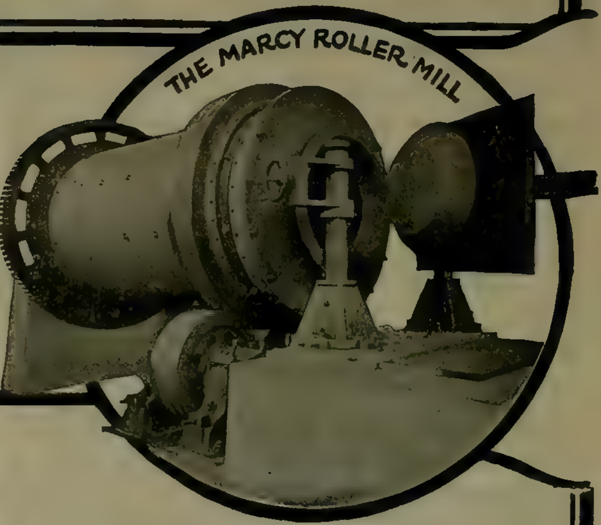

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EDITORIAL

T. A. RICKARD, ... Editor

ACCORDING to official figures, the Hollinger mine in 1921 yielded $10,031,050 in gold and silver from 1,072,493 tons of ore. The Hollinger Consolidated Gold Mines company earned a profit of $4,026,927, equivalent to 82 cents per share. Dividends aggregated 65 cents per share. The ore-reserve is estimated at $36,644,154.

OUR local papers for several days in succession placed the prefix 'Sir' before the name of Mr. Arthur Balfour and thereby mystified those who are usually well informed, because no announcement of his knighthood had been telegraphed from London. Only a few weeks ago Mr. Balfour declined both a dukedom and the Garter, so that it was entirely unlikely that he would accept an honor that goes to town councillors, caterers, and chocolateers. No, he remains plain Arthur J. Balfour, with a distinction that no title can improve. Formally, in Great Britain, but not in a newspaper article in the United States, he is "the Right Honourable", because he is a member of the Privy Council. He is also a member of the Order of Merit, which carries with it no title and has been given to about a dozen men of high literary and scientific reputation, including the late Henry James. Mr. Balfour declined an earldom from King Edward in 1905. He is one of the men so well born and so eminent in citizenship that no title would enhance his social status; in him the aristocratic tradition merges with the democratic. Meanwhile we are reminded again of the sophomoric ignorance of the scribes on our local newspapers, which are the least informed and the most despicable of any published in our language.

THE letter on 'Cyanide Regeneration' appearing under 'Discussion' has a melancholy interest, because it is posthumous. We regret to say that the writer of it, Harai R. Layng, died of influenza-pneumonia on March 4 at Gilroy, California. He had done much useful investigative work and promised to be a metallurgist of distinction; so his untimely death is particularly sad. The data given by Mr. George M. Cochrane on the treatment of concentrate will be appreciated by those who are operating silver-gold mines in remote localities. Mr. Leon Perret returns to the charge for the last time—in this paper—and controverts some statements made by Mr. S. J. Speak. We feel sure, however, that Mr. Speak, who is the president-elect of the Institution of Mining and Metallurgy in London, and a technician of the first rank, has not written carelessly on the subject of Russian placer mining, and we hope to read a reply from him in an early issue of the 'Journal-Press'. A valuable letter on the loading devices used underground is contributed by Mr. A. E. Ring, of Hailey, Idaho. Evidently he has had experience in the use of mechanical shovelers, and therefore makes sundry sensible suggestions. These constitute a compliment to the article by Mr. Colburn.

ON another page of this issue we publish a thoughtful and informative address by Mr. F. Wartenweiler, the incoming president of the Chemical, Metallurgical and Mining Society of South Africa. Mr. Wartenweiler is a Californian, the son of the late A. Wartenweiler, partner of Henry Bratnober—names that are reminiscent of early days in the West. He mentions the fact that metallurgic treatment now commences in the mine, citing the case in which the chemical control of mine-water is begun underground. We may add that metallurgic treatment may finish underground also, for cases have been known in which it was found practicable to leach the residue in tailing-filled stopes. The washing of all ore from the mine is an innovation that increases the duty of the stamp-mill because of the exclusion of fine material, which is usually moist and, incidentally, causes rust and decay in the bins and battery-foundations. As much as 15% of the ore is now being by-passed in this manner. The stamp-mill has survived, an increased span of life having been given to it by the wider adoption of the improved Nissen stamp, which at the New Modderfontein weighs 1900 pounds and crushes 31.5 tons per 24 hours through a screen with holes about one-half inch square. Scoop-discharges are used in the tube-mills; shell-liners of the Osborn and El Oro type are still favored. End-liners are being made from discarded stamp-mill shoe-shanks and dies. Ore is still used as a grinding medium in the tube-mills. Amalgamation plays a prominent part in the metallurgic scheme of treatment, as is logical. The cyanidation of the sand and slime has been improved by the adoption of several important modifications. The lowering of the strength and the de-oxidizing of the cyanide solution have caused important savings. The vacuum-filter is accepted as the standard equipment for the washing and de-watering of slime in new plants. The utilization of the zinc now wasted in the sulphate liquor from the acid-treatment plant, as described in our issue of February

18, doubtless will be a feature of operations in the near future. Mr. Wartenweiler indulges in some interesting personal reminiscences of early practice at the Homestake mine, and concludes with pertinent remarks on research and science. These deserve a wide publicity. The Rand as a goldfield is by no means dead; we wish it continued prosperity, for technology can ill spare the contributions to current technical practice that have made South Africa the metallurgic as well as the economic centre of the gold-mining industry.

DE BEQUE, a small town in western Colorado, owes what distinction it may have to the fact that it is the centre of a promising oil-shale district. Already shale-oil is being retorted successfully, and regular shipments are being made by several companies. According to the 'De Beque Shale News', the Monarch Shale Oil Company is supplying flotation-oil for 24 different concentrators in the United States at $10.40 per barrel in small lots or at $8.40 in tank-cars. Among its customers is the American Zinc Company, which uses the oil at the Mascot property in Tennessee. The Index Shale Oil Company has a retort-plant with a capacity of 100 tons of shale per day, at which regular operations are expected to commence soon; and the Oil Shale Mining Company has found a market for its product as a constituent of 'sheep-dip' and of medicinal soap. None of the plants in the vicinity of De Beque is equipped to refine oil, but the operation of them is paving the way for the construction of larger plants and for the introduction of refining equipment. It is said that the Union Oil Company of California has acquired 20,000 acres of oil-shale land near De Beque on which it spent $100,000 for prospecting and assessment work during 1921. Ventura Consolidated Oilfields is another corporation that has obtained rights to many thousands of acres, and the Pure Oil Company of Ohio has been actively engaged in the diamond-drill development of a 12,000-acre tract. The oil-shale and shale-oil industries in this country are in their infancy; but they show unmistakable signs of vigor; and as they grow, so should De Beque. On another page we publish a timely article on 'The Mining of Oil-Shale in Colorado', by Mr. R. L. Chase, the son and partner of Mr. E. E. Chase, of Denver.

YET another well-known Western institution has recognized the advantages of a consolidation with influential Eastern interests. We learn that the plant and assets of the Pelton Water Wheel Company, of San Francisco, have been sold to the William Cramp & Sons Ship & Engine Building Company, of Philadelphia. The name of the local company, so well known throughout the world, is to be retained. The following gentlemen are to direct affairs: president, Mr. H. B. Taylor, the vice-president of the William Cramp company; vice-president and general manager, Mr. Ely C. Hutchinson, formerly chief engineer for the Pelton company; second vice-president, Mr. William M. Moody. The West, particularly California, owes much to the initiative and inventive genius of Lester A. Pelton, who in the 'seventies developed the impulse-wheel that bears his name, the manufacture of which was taken over by the original Pelton Water Wheel Company, organized in 1887. For some years after its inception the concern confined its attention to the manufacture of impulse-wheels; later it attracted attention in connection with the design and construction of high-head reaction-turbines. Last year the Southern California Edison Company installed two 25,000-hp. units of this character at its Kern River No. 3 plant. The *raison d'être* of the present reorganization is apparent when it is realized that the William Cramp company is noted for the construction of some of the largest reaction-turbines in operation, besides being a shipbuilding corporation of international reputation. Readjustments and combinations such as this are inevitable, for they lead to the avoidance of the wastage that is incurred by unprofitable competition; they facilitate the co-operation of specialized talent and experience.

IN his presidential address to the Canadian Institute, Mr. C. V. Corless said many things that are interesting, among them being his reference to the area of pre-Cambrian rocks in which so many valuable ore deposits have been found. He pointed to the fact that less than 3% of the total pre-Cambrian area in North America extends into the United States, notably into the States of Michigan, Wisconsin, and Minnesota. This region, however, is one of the richest in mineral wealth, for it includes some of the most important iron and copper deposits in the world. In Canada the pre-Cambrian area includes the districts of Sudbury, Cobalt, and Porcupine, besides numerous other mining districts; it extends to Hudson's Bay and to the Arctic shore—an enormous extent of country in which prospecting is yet in its infancy. Our readers will recall that Dr. Willet G. Miller, Provincial Geologist of Ontario, drew attention to the probabilities of further mineral discoveries in this terrain, which, as he said, constitutes one of the largest unprospected areas in the world. In this context the Flin Flon and Mandy copper discoveries in Mantitoba are suggestive, so also are more recent gold finds in western Ontario. The pre-Cambrian area, or Laurentian shield, is characterized by a bare rocky surface, for intense erosion and recent glaciation have scoured this part of the earth's face and left it open to the prospector's inspection, save when the snow covers it or where the moss and swamp veil it from his curious eyes. Mr. Corless, in referring to the erosion and the removal of the soil southward into the United States, says: "When Nature transported the soil from this half of Canada to situations climatically more suitable for agriculture, she balanced the loss to future populations by making possible the discovery of inconceivable mineral wealth, which will amply compensate for the greater faith, larger risks, more far-seeing enterprise, and sturdier manhood, necessary for its discovery and development". We hope for success to that discovery and development, for the Canadians are our friends and we wish them well in their enterprise.

The Journal-Press

We are receiving letters of regret at the passing of the 'Mining and Scientific Press', as might be expected. Indeed, we would be sorry if the event did not elicit some such expression of sentiment. Shall we be deemed ungracious, however, if we say that the mining engineers that express such regret might have used their influence to prevent the organization of their own profession—the Institute—from breaking into the business of commercial publishing, that is, from an illegitimate competition with an independent technical paper, the passing of which they now bewail? It is evident that many of our readers assume that the consolidation is one in name only, and that the oldest mining paper in the United States has been gobbled by the 'trust'. One of our best friends says: "It is with genuine regret that I see the 'Press' in the group of syndicated papers. I admit the inevitable, but am sorry that changing conditions point this way. 'Mining and Metallurgy' [the Institute magazine] will have to play the unsyndicated rôle". Yes, the trend of the times is toward consolidation and toward the larger organizations of enterprise; but the fact that an organization is large or that a corporation is wealthy does not of necessity make it a sinister aggregation. The McGraw-Hill Company is not a syndicate, but a publishing company that controls a number of trade and professional periodicals. In consequence, it can do things in a comprehensive way and usually in an inexpensive way, per unit, because its 'overhead' is spread over some twelve or fourteen publications. The salient fact is that the head of the business, Mr. James H. McGraw, has nothing to do with mining or smelting affairs, so that the policy of his mining paper is guided entirely by its editor, Mr. J. E. Spurr. He—Mr. Spurr—is one of the least likely to brook outside influence; indeed, he has been—and is—as independent as the editor-publisher of the 'Mining and Scientific Press'. To suggest that the 'Journal-Press' will lack independence because it is owned by a well-organized publishing company and that 'Mining and Metallurgy' will be the only periodical left to pursue an independent policy is exactly contrary to the fact, for the Institute magazine is controlled by a small group of men in New York identified with the large mining and smelting corporations, and with the manufacturers of the equipment they use. The editor of that magazine is not nearly as independent as either Mr. Spurr or the contributing editor of the 'Journal-Press' in California. As to the genuineness of the consolidation, *qui vivra, verra.* The entire editorial staff—three writers—of the 'Press' will join the staff of the 'Journal'. Mr. Allen goes to the San Francisco office; Mr. Parsons to New York; and Mr. Rickard remains here so as to be in a position to maintain close touch with Western mining affairs. Results will speak for themselves. We expect confidently that the mining industry will be served by a paper better and larger than any mining paper that has been published before, and that it will be conducted in a spirit worthy of the national mining journal of the United States.

Government Publications

There are two sides to every question. As Mr. George Otis Smith, the Director of the U. S. Geological Survey, states in his annual report, book-keeping deals with cash expended, not with material achievement; a balance may show that money has been saved or that work has been left undone. Something more than a statement of dollars and cents is needed to permit intelligent judgment as to whether or not the non-spending of public funds is a sign of economy or an index of inefficiency. The public, Mr. Smith says, demands from a Government bureau more investigative work than can be done without exceeding the appropriations provided by Congress. Another limitation that defeats economy in administration is due to the restriction in the selection of personnel. Rules that limit the number of Government employees from the same family and from the same State indicate that the Civil Service is still a trough at which political pigs are fed. The tendency, says Mr. Smith, is to protect the holder of a Government job regardless of his capacity or ability. The public service needs and deserves the best and most talented workers, so that such an attitude is out of harmony with the demand for more businesslike methods in all the departments of the Government. The relatively small salaries paid by the Government constitutes a further handicap in the efforts at greater economy made by the Director of the Geological Survey. Competition with outside employers has been keen, and this has resulted in the resignation of several specialists who occupied key positions in field investigations. The loss in efficiency due to interrupted work has far outweighed the savings that may have resulted because of lower scale of pay.

Our sympathy is with the Director in his efforts to remedy this condition of affairs. At the same time it must be admitted that the Survey's publications deserve special mention for their value to the industry, for their originality, and for the careful and painstaking manner in which they are edited before being printed. This last feature is not of minor importance. Government bureaus need the support of the technical press; and this will be given all the more freely if the publications, which constitute the only index to work done, are submitted in a form indicating that care has been taken in revising and editing. This work must be done by somebody; if avoided by the staff of the bureau it is obvious that it must be done by the editor of the paper in which publicity is sought. But the editor has many other duties, and so the work may be hurried and often is done unsatisfactorily. The greatest fault in most Government bureau publications is lack of condensation. If the editor of a technical paper is asked to give publicity to an article that can be reduced appreciably in volume without detriment to its clarity, and without the deletion of pertinent facts, he is obliged to undertake the task, to save expense in type-setting, proof-reading, correction, printing, ink, and paper. Some authors refuse to realize the imperative necessity for brevity consistent with clarity. Those in charge of the publication departments of some of our

Government bureaus at Washington would do well to imitate the U. S. Geological Survey in its efforts to maintain a high standard for a limited outlay. Quality rather than quantity should be the ideal. If they secured the services of editors as conscientious and capable as is Mr. George M. Wood they might be able to approach the Survey in excellence of output.

Labor Turn-Over

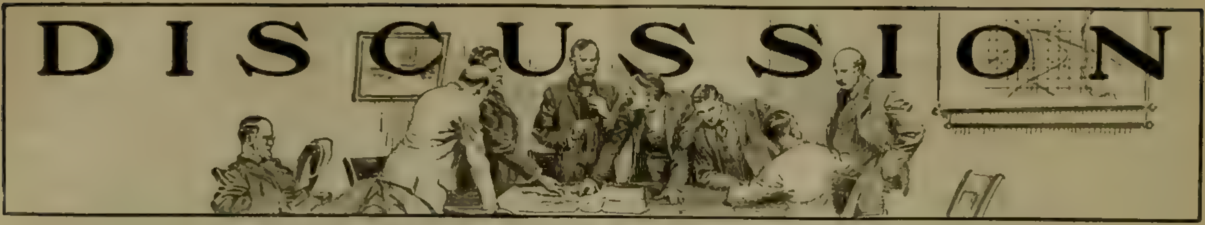
Unnecessary labor turn-over was mentioned recently by Mr. Hoover as one of the principal causes of waste in industry. By labor turn-over is meant the discharge or resignation of an employee and his replacement by another. The expense involved, when conditions are such that only a few men stay on the payroll of the company for any length of time, is considerable; but it is not calculable with exactness. In some cases the cost of a medical examination is met by the employer, who must also make provision for the necessary instruction and training; for even though the newcomer be skilled to an unusual degree, he is seldom able without training to step directly into the shoes of his predecessor. During this period there is a disorganization and an interruption to ordinary routine that is costly. The work of the regular employee is disturbed and there is a considerable wastage of time and material before proficiency is attained by the newcomer. A choice of help is seldom practicable; any change of staff introduces an element of risk. The result may be good or it may be bad, but there is nothing so demoralizing as uncertainty. During the period of training it happens usually that excess work devolves on other members of the organization, but no estimate can be made as to how great is the adverse effect of this. One of the publications of the National Industrial Conference Board gives the total cost per new employee—to include the expense of hiring, instruction, wear and tear, as well as a monetary equivalent to reduced and spoiled work—as follows: Highly skilled mechanics, $48; ordinary mechanics, $58.50; semi-skilled piecework, $73.50; laborers, $8.50; and members of the clerical force, $29.

Excessive labor turn-over is preventable. The method adopted so successfully in some quarters to reduce it to normal serves to indicate the cause of the trouble, which is primarily an absence of contentment. This, in turn, arises from insecurity of tenure, an anxiety in regard to future illness or accident, a feeling of inferiority because life is the hand-to-mouth kind, and dependence on profiteering landlords or exposure to unfavorable discrimination by them because of normal and legitimate domestic responsibilities on the part of the tenant. One remedy is adequate pay, but this is only effective provided certain conditions are observed. Few there are who will be unwilling to admit that the indiscriminate raising of wages is undesirable. As a remedial measure it often defeats its own end, because everyone should be, but few have been, educated to handle money. How then can excessive labor turn-over be avoided? The answer is apparent to anyone who has been privileged to study Mr. Henry Ford's methods. His company was never able to make a choice of applicants for employment on the basis of quality. In 1917 the Highland Park plant employed 40,000 men; these were representative of 58 different nationalities, so the throng was heterogeneous. Before serious attention was paid to sociological problems the labor turn-over was considerable. The peak of inefficiency in this respect was reached when 50,448 men left the plant within one year. This necessitated remedial action; the essential feature of the plan adopted was to give increased pay on the basis of increased profits, but—and here is the essence of the remedy—only on conditions that prevented an improper expenditure of the bonus.

It is obvious that no good result can come from higher wages if increased remuneration be spent and wasted. During 1914 only 60% of the employees of the Ford factory received the bonus. This was not due to failure while at work but to failure while away from work. The employer has obligations in this respect, and these Mr. Ford realized. An educative campaign accompanied the offer of the bonus. The number of men who now are not entitled to and who do not receive the bonus amounts to less than one per 1000. This indicates a remarkable achievement. The public benefits directly from the adoption of so far-sighted a policy. It shows that no economical operation is possible until men are paid not only the equivalent of the worth of their labor, but enough in addition to enable them to share with the capitalist the feeling of contentment that springs from an ability to add to a growing reserve of savings—to be able to meet without borrowing or distress the unexpected demands of sickness or accident.

It is shown by official accounts that when Mr. Ford was benefiting from the good effects of his scheme the Bureau of Labor reported that other factories in the same town had a labor turn-over of more than 600%. Mr. Ford pays high wages—a minimum of $6 per 8-hour day was established on January 1, 1919—but the question is not what he pays but where the money goes eventually. A comparative analysis of the financial condition of 100 employees showed that in five years the average amount deposited in savings banks and invested in homes and lots had risen from $207.06 to $2171.41; the amount of life insurance had been increased during the same period from $186.53 per man to $857.03 per man. These are significant figures. They explain in a measure why Ford cars are so cheap today. They indicate that no effective and permanent settlement of any labor dispute can be made until the employer goes behind the scenes and finds out what is happening to the wages he is distributing. He is entitled to make the analysis. The employee is foolish if he shows aversion from such action. If the employer neglects to do this he is depriving himself of valuable information as to how the men in his employ can be made more contented; he is to blame for inefficiency, for the discontent that arises from ignorance, and for the disorganization that results from excessive labor turn-over.

DISCUSSION



Underground Loading Devices

The Editor:

Sir—Noting the interesting article by Mr. Colburn in your issue of January 28 on this subject, I would like to comment on one class of machines mentioned, namely, mechanical shovelers.

It is an exceedingly hard matter to keep accurate figures on operating costs for these machines, as any practical mine-operator knows. Even assuming that the various figures given in the article are approximately correct within a small percentage, there is one matter which seems to have been conscientiously avoided, presumably by the companies furnishing the data, with the exception of the case of the Priest Portal data. This is the matter of first cost and depreciation. You will note that the Priest Portal data indicate five years allowed for depreciation at 20%, equal to \$1944, from which it is presumed that the first cost was around \$9720. The smaller machines like the 'Shuveloder' cost considerably less, but, as a rule, have a smaller capacity per shift. Their costs run into the thousands of dollars also.

In some instances it is noted that, after two or three years, repairs become heavy; in fact, the data indicate that repairs on the larger machines run from 25 to 65% of the cost of shoveling. It is also noted that some of the machines were practically re-built in the course of a few years. It is very hard, therefore, to estimate the life of a machine of this kind; if, in the course of, say, three years a machine has been practically re-built, and the cost charged into current repairs in getting the per-ton costs, one can hardly say just what is the life of the machine, and consequently, what depreciation should be charged yearly against the machine. For the purpose of getting some idea of this, assume the first cost of a machine as \$10,000 and allow five years for depreciation, \$2000 per year, charging current repairs into current costs. Let us assume that, at the end of five years, instead of being ready for the junk-pile, the machine has a sale value of \$5000. We would then only have a net charge of \$1000 per year to take up in operating costs. Assume again that the machine averages 125 tons per day for 25 days in a month, or some 37,000 tons per year. The depreciation charge would then be about 2.7 cents per ton. In addition to this, the \$10,000 investment is tied up in the machine, and at 6% interest would mean another \$600 per year, or \$50 per month, to charge against operating, or, say, 1.6 cents per ton. I believe that these and other miscellaneous charges would increase the cost of shoveling some five or six cents, possibly more, above what the data in the article would lead one to believe this cost to be. In other words, instead of the cost of machine-shoveling at the St. Joseph Lead Co.'s mines being around 19 cents, it should be around 25 to 26 cents per ton.

Another thing to take into consideration is the fact that repairs form a large percentage of the per-ton costs—25 to 65%. The machines cannot be depended upon to work day after day, like a hoist or a motor, over long periods. In many mines it is a necessity for the tonnage to come out regularly; the result is that, to do this, at least two machines must be kept on the job, or, if more are used, one must be kept in reserve. This means a further increase in the investment tied up in these machines. I might add here that this matter of investment and depreciation is brought up because with hand-shoveling, there is no investment. Where such an extra machine is kept, it would seem proper that its maintenance and other charges connected with it should be charged against the total tons shoveled; but how much this would amount to is a difficult thing to say. On the other hand, if no extra machine is available, then, if the tonnage is to come out as per schedule and the one machine is down for repairs, hand-shoveling has to be resorted to. Here again costs are involved that are hard to state definitely; if the machine is of the caterpillar type, temporary tracks have to be laid to the muck-pile; if the machine runs on a track, it is presumed to be shoveling for, say, 10 ft. on either side of the track, and this condition would not allow of efficient hand-shoveling—either different tracks would have to be laid or else the shoveling would be concentrated at the end of the machine-track. In either case, these temporary tracks would have to be removed before using the machine again, and the cost of the hand-shoveling would be excessive; this excess would be caused by the breaking down of the machine and should therefore be charged against the machine. Again, it would be hard to say just what this would amount to.

In stopes similar to those found in south-eastern Missouri and in the Joplin district, with a wage of \$4 for muckers, which is high, straight hand-shoveling costs will run around 22 to 23 cents; in some places it may run a little higher, while where conditions are favorable it will run less. It would seem therefore that on a basis of cost per ton shoveled it would be a difficult matter to decide whether machine-shoveling was worth-while in many cases. When the tonnage per man per shift is considered, however, the machine has the best of it, and this has been the governing factor in many instances.

With the larger machines, a crew of from two to four men is indicated for a tonnage of around 125 tons per shift; four men hand-shoveling could hardly be expected to average more than 70 to 80 tons per shift, so that we would have an output of, say, 31 tons per man per shift with the machine, against 17 to 20 with hand-shoveling; and when labor is scarce this is an important factor.

While on the subject, it might not be amiss to point out one rather important condition in underground mining that has a considerable influence on the matter of mechanical shoveling. In many mines, ore as broken in the stopes has to be passed down raises, through chute-doors, skip-pockets, hoisted in cars, skips, buckets, etc. It is necessary, therefore, that all boulders be broken up to a maximum of 18 inches and sometimes less; otherwise there will be continual delays at the loading-chutes and pockets. This necessarily holds back the machines in underground work, as in many cases they can pick up much larger boulders than that. Another condition that often exists is that cars of fixed size have to be used to fit the haulage from the other stopes where hand-shoveling has to be used. The car used with a mechanical loader should be as large as possible—the larger the better—for it means less time lost in changing cars and switching or tramming; and time is very important where machines are used.

This letter is not written with the idea of condemning underground mechanical shovels. I had some two years experience with one of the earlier types some five years ago and the later machines are undoubtedly far more durable and efficient than the one I used. There are places, both on surface and underground, where the types of loaders mentioned in the article have many arguments in their favor; and, again, the labor question may, at times, be far more the prime factor than the question of per-ton costs. Neither is it intended to criticize Mr. Colburn's article, which gives an excellent digest of the results accomplished with underground mechanical loaders; rather it is meant as a supplement to the article, with some few points indicated that might not be at first considered by one who was planning on using mechanical shovels.

A. E. Ring.

Hailey, Idaho, February 5.

Synthetic Gold

The Editor:

Sir—In your issue of February 18, I note that you say: "The discovery of a process by which gold could be made would so demoralize our monetary system that we might be compelled to adopt the commodity dollar of Professor Fisher".

If it would not be asking too much I would like to have Professor Fisher tell me what he means by a commodity dollar. I assume he means a dollar as a basis for a monetary system whose value is determined by the value of a limited group of standard commodities. John Stuart Mill made the statement that "the value of money is inversely as general prices, falling as they rise and rising as they fall". If Professor Fisher means to abandon the gold-dollar basis in favor of the commodity dollar, as I understand it, I think he has made the same error that Mr. Mill did. The gold dollar is the standard. As prices rise, the dollar will buy less, but if you consider the purchasing value of a dollar as depreciated, you could not at the same time recognize that general prices had risen, as you would be using general prices as the standard of value instead of the dollar.

To my mind, however, it would be feasible to strengthen or stabilize the value of a gold dollar, and perhaps a commendable move, by fixing the relative prices of a group of standard commodities on the basis of a gold dollar. Such procedure would necessarily involve supporting these fixed prices by establishing an agency which would both buy and sell these standard commodities at such fixed prices. To do this, large storage facilities would be necessary, for to maintain the price of a given commodity this agency should be prepared to buy without reserve when there was a tendency for the price to fall, and to sell without limit at the fixed price when the tendency was for the price to advance. An agency with such powers could be possible only either at the instance of a large trust, such as the Standard Oil, or by the United States government, which really is the only agency which should be entrusted with such powers.

Roy H. Kingsbury

Interstate, Idaho, February 21.

Russian Placer Mining

The Editor:

Sir—Mr. S. J. Speak evidently possesses a sense of humor, as manifested by the letter published in your issue of June 18, 1921, in which he ventures to prove the superiority of electricity as driving-power for dredges by comparing the performance of the Kolchan electric dredge, a boat of latest design and the best in dredging equipment, with that of a digging appliance composed of the parts of an old stacker-scow to which the attributes wanting to make of it a sort of steam-dredge were added.

I hope Mr. Speak will admit that the amount of fuel consumed depends foremost on the boiler. Now, the main features required for boilers used on any kind of excavator, drag-line, steam-shovel, or bucket-excavator are compactness and rapidity of steaming, and these features can only be attained to the detriment of economy in fuel consumption. The boiler that was quite satisfactory for the stacker-scow could only prove entirely inadequate for the steam-dredge in question, as shown by its abnormal fuel consumption. Such consumption is not representative of steam-dredges in general. I may inform Mr. Speak that each of the two Schouvaloff dredges (open-connected) with buckets of the same capacity as the Pokroffsky steam-dredge ($3\frac{1}{2}$ ft.) accomplished on an average 150,000 cu. yd. per season with a consumption of wood fuel of some 200 cubic sagenes, that is, more than six times less than the results stated by Mr. Speak, notwithstanding they operated in much harder ground than the dredge of the Orsk Goldfields.

Mr. Speak ignores entirely the size of the buckets, which is the main factor determining the yardage, and he is hopelessly wrong in stating that "though the steam-dredge has much smaller buckets and operates under rather more difficult conditions, those disadvantages cannot account for the fact that the electric dredge accomplished more than five times the yardage per unit of fuel consumed than the steam-dredge does". Anyone who has a thorough knowledge of the subject will agree that the construction and the inadequateness of the boiler, the smaller size of the buckets (3½ ft. as against 7½ ft.), and the "rather more difficult conditions" are quite sufficient reasons for the excessive fuel consumption in relation to the yardage of the Orsk Goldfields steam-dredge.

Mr. Speak's figures may be of interest to the shareholders of the company as items of expense, but from an engineering point of view they are of no value whatever, least of all as an argument in favor of electricity v. steam in gold-dredging.

L. A. PERRET.

Yokohama, February 8.

Cyanide Regeneration

The Editor:

Sir—With reference and in reply to Chas. Lintecum's notes and question on the above subject, appearing in your issue of February 18, I am pleased to present the information desired. I devoted about three years, beginning in 1912, to study, laboratory work, and practical experiments on cyanide-regeneration methods. I took out American and Mexican patents on processes resulting from my work. The greed of capitalists and mine-managers, the professional jealousies of pseudo-metallurgists, and lack of finances caused the suspension of the work.

Numerous tests, probably numbering more than 1000, on a laboratory scale, on a one-ton scale and over, were conducted by me. The large-scale tests were as successful as the small-scale tests, and all indicated that acid regeneration is practicable and could be conducted in many cases at a considerable profit.

In 1913 the manager for the Goldfield Consolidated Milling & Transportation Co. (Mr. Albert Burch) kindly offered me the opportunity of demonstrating my processes. This I did on a one-ton scale, but as the cyanide consumption was low and as fresh solutions did not yield any better extractions on the ore than did used solutions, I did not recommend the process. I did not wish to risk the chance of failure because of the low margin of profit, about 20 cents per ton, indicated by the tests. I preferred to install the first plant in a mill where there was a larger margin of profit.

I selected a mill where laboratory tests indicated that a probable profit of over $1 per ton could be gained by the application of my methods. After conducting numerous tests I recommended the erection of a 40-ton (solution) experimental plant. I designed the plant hastily and it was partly installed, not at the mill where I had conducted my tests and based my calculations, but at one where the solutions were badly fouled and where the extraction had dropped so far below normal that for at least one month before my arrival the company had been losing money. Operations were commenced before the plant was completed. There was so much solution on hand that the treatment of only 40 tons per day would be insufficient to remedy the ills, therefore about 150 tons per day was rushed through the plant. The solution was cleaned, but the regeneration of cyanide was low because the makeshift recovery device was too small to handle the gas. However, the regeneration amounted to 85% of that shown in laboratory tests, and the results were all that could be expected of a new plant using an untried process at four times its designed capacity; they were sufficient to demonstrate the success of the method. When the plant had been running for about two days I was handed a contract that would have taken all of my patent rights away from me without reimbursement; I was told to sign it or get out. Needless to state, I got out. The mill operators tried to run the plant, but they did not know as much as I knew, and consequently they abandoned it. I tried to interest a number of people in the processes but could not do so. Circumstances prevented me from doing anything further in the matter. Since that time my work on chloridizing volatilization has taken so much time that I could not afford to work on cyanide regeneration. However, I intend to take this up again as soon as I have established the chloridizing volatilization processes.

Practically all the cyanogen that can be converted to hydrocyanic acid by means of acids, chemicals, or electrolysis can be removed almost completely from the solution and the hydrocyanic acid so removed can be recovered as available cyanide in a highly concentrated form, by means of alkali or alkaline-earth oxides. In order to determine the amount of cyanide that may be regenerated it is necessary to know how the cyanide was consumed. Little attention has been devoted by others to this. Many publications indicate misconception on the part of the authors as to the formation of various salts in cyanidation. Copper from sulphide ores is taken into solution in the form of $Cu_2(CNS)_2,6KCN$; hence only about 75% of the cyanide consumed in forming the copper salt could be regenerated by acid. The $Cu_2(CNS)_2$ precipitated formed by acidulating the cyanide solution containing it is not affected by H_2S. The treatment of that precipitated by means of an oxidizer like dilute nitric acid in the presence of dilute sulphuric acid and heat will result in a conversion of over 85% of the sulpho-cyanide to hydrocyanic acid. The treatment of the solution with dilute sulphuric acid and potassium permanganate in the cold will result in an almost complete conversion to hydrocyanic acid, which can be recovered as available cyanide by passing air through the solution so treated and thence through milk-of-lime or a solution of caustic soda.

Carbonate of copper or like minerals react with alkaline cyanide solutions, with the formation of a cyanate according to the equation:

$$2CuCO_3 + 7KCN + H_2O = 4KCN,Cu_2(CN)_2 + KCNO + 2KHCO_3$$

The treatment of a solution containing this copper salt should result in a regeneration by acid of about 57 1/7%, or a regeneration by a reducing reagent (such as H_2S) of 28.5%, making a total of 85.66%. The cyanate is not affected by H_2S.

In testing I have taken some ores and treated them with a measured amount of cyanide, then removed the solution and wash-waters. The solution and wash-waters were then treated, and over 99% of the cyanide added to the ore was recovered in the form of a strongly concentrated solution. Almost all the cyanogen was removed from the original solution. In cyclic work the recovered cyanide gave results equivalent to those obtainable with new cyanide. Solutions so treated can be re-used after neutralizing, and they give results equivalent to those obtainable with freshly-prepared solutions.

Passing air through a solution for 24 hours would cause prohibitive costs for power and installation. I worked out a method and device by which the hydrocyanic acid was completely removed in less than 20 minutes, with the expenditure of less than 0.0064 hp-hr. per ton of solution. This could be improved. The process was continuous and precipitation was complete. The recovered cyanide never analyzed more than traces in cyanate, so that there is no foundation for the belief as to a loss due to the formation of cyanites.

Recently a well-known cyanide operator told me that he condemned the acid-regeneration scheme because he could not determine the amount of acid required. I had this trouble when I first started work and soon developed an infallible method. This consisted of adding a measured amount of standard acid solution in excess to the test, then heating the mixture for 10 minutes to near boiling, then filtering and washing, then titrating with a standard alkali solution, using methyl-orange indicator. This method is accurate to within 0.01 or 0.02 lb. of acid per ton of solution, and this is all the excess acid that is necessary for safety. Sulphurous acid will yield results equivalent to those produced by sulphuric acid, but the application of the sulphurous acid requires a different plant to that required for sulphuric acid.

This method of regeneration ensures fresh solutions and, consequently, increased extraction. It accomplishes a complete precipitation of the gold and silver. It avoids the large mechanical loss of cyanide that otherwise is inevitable. It requires little attention and can be operated by the ordinary crew. The only unknown factor is the life of the porous medium through which the air is introduced to the solution.

Harai R. Layng.

San Francisco, February 19.

Treatment of Concentrate

The Editor:

Sir—In your issue of February 18 there is an article by E. P. Crawford on the treatment of concentrate. One can see from the following liquidation that there is no profit for the miner to ship to smelter. Take, for instance, the following figures that refer to the fairly high-grade ore:

		Dr.	Cr.
Gold, 0.92 oz., less 0.046 oz. = 0.874 oz.,	at $19.00 =		$16.60
Silver, 272.28 oz., less 27.228 oz. = 245.06 oz.,	at 78.75 =		192.94
Iron, 15%	at 0.06 =		0.93
Silica, 51%	at 0.08 =	$4.08	
As,Sb, 6%	at 0.30 =	1.80	
Treatment		4.50	
		$10.38	$210.47
			$10.38
Net per ton			$200.09

Price of silver, $0.85 per oz., less $0.0625 for smelter.... $ 0.7875 per oz.
Price of gold, $20.67 per oz., less $1.67 for smelter...... $19.00 per oz.

Weight of lot	1853 lb.
Weight of sacks	19 lb.
Weight of dry ore	1834 lb.
1% moisture	18 lb.
	1816 lb. = 0.908 ton

	Dr.	Cr.
Total value		$181.68
Taxes	$27.25	
Sampling and assaying	3.50	
Freight to smelter	10.89	
Commission	18.17	
		59.81
Net value		$121.87
Total value of lot: gold, $17.70; silver, $210.95		$228.65

Out of the net return the miner had to pay the cost of mining and the freight to the railroad.

On lead-silver ores of the following there is no profit whatever:

		Dr.	Cr.
Silver, 30.4 oz., less 5% = 28.9 oz.	at $0.60 =		$17.34
Lead, 43.5 lb., less 10% = 738 lb.	at 0.20 =		15.66
Lime, 8% Iron, 12% } 20%	at 0.08 =		1.60
Insoluble, 41%	at 0.12 =	$4.92	
Sulphur, 4%, less 1% = 3%	at 0.30 =	0.90	
Treatment	=	5.50	
Taxes	=	0.82	
Freight to El Paso	=	7.90	
		$20.04	$34.60
Net value per ton			$14.56
Total value, per ton, of contained silver and lead			61.24

The best mode of treatment would depend on the general class of ore in each district. For instance, if the aggregate were a mixture of lead-silver base ores it might be a smelting proposition; but, should it be a straight silver sulphide, it might be better to adopt a leaching process. The price of fuel, labor, and freight, and the distance from railroad would have to be considered. Sooner or later some company will erect a reduction plant at a point on the west coast of Mexico, where ores such as Mr. Crawford refers to can be treated at a profit for the miner. With both rail and water transportation, it should be a fairly good investment for a company that understands the business. At the present time, there is no profit for the miner who ships ore or concentrate to the smelter; the only plan is for each district to reduce its ore to bullion or high-grade matte.

Geo. M. Cochrane.

Suaqui Grande, Sonora, Mexico, February 20.

Mining Laboratory of the Missouri School of Mines

By C. R. Forbes

In the year 1913 the Missouri School of Mines and Metallurgy opened up a small experimental mine for the purpose of supplementing the class-room study of mining operations with a laboratory where practical demonstrations might be given. It was not started with the idea of giving a 'practical' course in mining, and it has never been used for that purpose.

The mine is about 1½ miles from the school at the site of an old dolomite quarry. It is the nearest point available where suitable rock can be found. A small tract of land containing about 9 acres was purchased for a nominal sum. The topography is such as to permit of a tunnel being driven into the hillside so that eventually it will have about 30 ft. of cover.

A power-plant consisting of a 50-hp. boiler and an Ingersoll-Rand compressor of 100-cu. ft. capacity was installed. It was not deemed advisable at that time to spend much money in equipping the mine as it was an experiment, and its utility as a laboratory had not been demonstrated. The total original expenditure, including the cost of the ground, was less than $2000.

Work was carried on with this small plant for several years. The tunnel-heading was advanced a hundred feet and several side-drifts were run. Feeling that the success of the laboratory had been demonstrated, the School decided to enlarge the plant, which was done last summer. The present plant, although much larger and better than the original one, does not represent an expenditure of much money. All the machinery was either purchased at second-hand or had been discarded from other use around the School. The total expenditure during the past summer was approximately $6000. The plant as now equipped has all the elements of a real mine and is a most valuable aid in illustrating the problems of mining.

The present power-plant consists of a 125-hp. horizontal return-tubular boiler, two air-compressors with a total of 250 cu. ft. capacity, and one 35-hp. Erie engine, which is used to run the crushing machinery. Water for the boiler is pumped from a near-by stream by a centrifugal pump belt-driven from a gas-engine. The water is pumped into a concrete tank of 4000-gal. capacity. During times of drouth water may be obtained from a well 160 ft. deep by means of an air-lift.

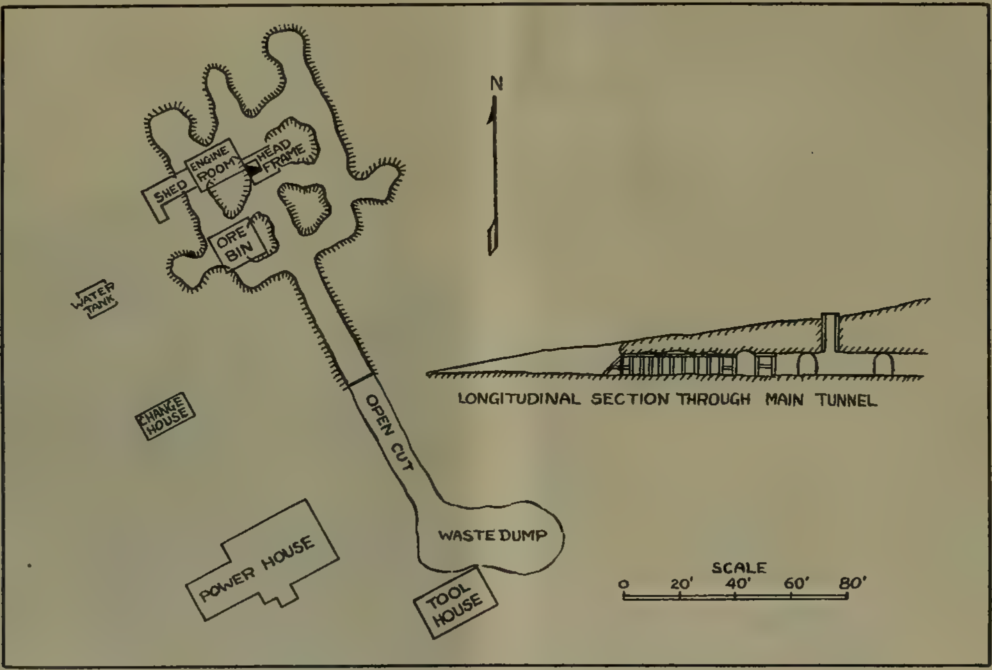
Until this year it had been the practice to tram the rock from the tunnel to a dump. In order to utilize the rock and also to make the plant more complete, a shaft was put down to the tunnel and a Joplin type of head-frame was erected over the shaft. An English Iron Works 10 by 12-in. geared hoist was installed in the head-frame, and with this equipment the rock is hoisted to surface, where it is dumped into a small bin. From the bin it runs by gravity either to a Blake crusher or to a Jeffrey combination jaw-crusher and hammer-drill. When rock for concrete or for road purposes is desired, the material is run through the Blake. The hammer-mill, which contains ½-in. screens, is used to produce pulverized lime for agricultural purposes, for which there is a good market. The rock is worth $1.50 per ton either for concrete or as agricultural lime. The crushed or pulverized material is hoisted into a 100-ton storage-bin by a belt-bucket elevator, from which it may be hauled to town by truck.

The accompanying drawing and photograph show the arrangement of the plant and mine. The workings now total about 500 feet.

THE MINE

The chief item of interest, however, is not in the equipment itself, but in its use. The questions that naturally present themselves are: How much time does a student spend in this laboratory, what does he do, and what does he learn?

The total time spent by a student in the mining laboratory is 40 hours out of his four-year course. This work is done during the first half of the junior year and represents less than 1% of his total course. It is evident that it is not the aim to make drill-runners or practical miners out of students. Most of the time is spent in drilling and blasting, but, as occasion demands, the student may be called upon to do track-laying, timbering, or shoveling. Drilling is done with dry and wet 'Jackhamers', with large mounted hammer-drills, and occasionally with stopers. The work is so arranged that only two men are employed on one drill at a time, and whenever possible they are given a working-place to themselves where they may drill and blast a complete round. The work is practically all drifting in headings from 6 to 10 ft. wide and 7 ft. high. Different types of rounds and different kinds of explosives are used, the results being recorded and compared. The actual information gained from this work itself may be small, but without it the entire study of rock excavation in the class-room becomes a mere matter of books and imagination. It is true, many students labor during their summer vacations at similar work and gain much better practical experience than can be obtained in any laboratory. Such men may be given credit for this work. It is also true that the summer work done by students is greatly varied in character and usually only a small percentage of one class will have had actual underground experience. Some men who have 'mucked' for a summer are glad of the opportunity to run a drill, in the hope that the experience may help them in getting something better than a 'mucker's job' in the following summer.



EXPERIMENTAL MINE OF THE MISSOURI SCHOOL OF MINES

The mining laboratory in no sense supplants the summer work, which is a part of the required course at this school as at many others. It is simply a laboratory used to supplement the class-room study of mining operations and for the study of such subjects as explosives, rock-drilling, blasting, tunneling, shaft-sinking, and timbering it has proved most valuable in increasing the student's interest in these subjects.

Perhaps the greatest advantage of having the experimental mine as a laboratory, and one not anticipated at the beginning, is in its use for practical instruction in mine-surveying. It was not deemed large enough for this purpose until last year. Previous to that time it was the custom for the class to take a mine-surveying trip to an Illinois coal mine or to a lead mine in south-eastern Missouri, at an extra expense of at least $50 per man. Doing the work in the laboratory represents a saving for the present class of $2500. From this standpoint alone the expenditure for equipping this laboratory has been more than justified. Aside from the financial consideration, the fact that the instructional work can be given much more thoroughly is a decided advantage. On the trips as formerly taken, the class was divided into groups of four; each man in a group was supposed to have his turn at the instrument; but when an instructor was not around, it is quite likely that the best man in the party (by common consent) was running the instrument. The work as done here is done in groups of two, one man running the instrument and the other acting as helper. Finally the operation is repeated, but using different stations, the other man running the instrument on a complete survey so that each man has an equal opportunity. Each party plumbs the shaft with two wires and also runs a line down the shaft using the top telescope. The fact that the work is done in groups of two, and that it can be closely supervised and checked, and that a complete survey and map are made by each man individually has convinced me that the instruction is much better than was formerly given on the hurried trips to the mines. The only disadvantage is the smallness of the mine, but this disadvantage will grow less in time.

Work of the Geological Department at a Porphyry Copper Mine—I

By X. B. Starnes

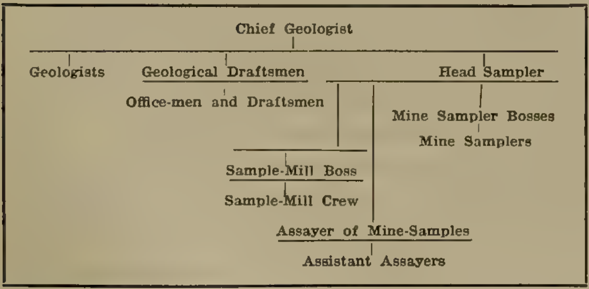
INTRODUCTION. Copper mining is a business; the object of the geological department of a copper company is to produce a profit in dollars and cents. The work done, therefore, differs somewhat from the work of scientific institutions, such as universities, and of Federal or State geological surveys.

The following notes are based mainly on the experience that I gained while chief geologist of the Morenci branch of the Phelps Dodge Corporation, and in part upon other experience. The methods outlined do not follow in detail that of any particular company, and the data given are taken from the work in many different localities.

The work of the geological department of a company mining large quantities of low-grade copper ore by underground methods, or by a combination of open-cut and underground methods, consists of obtaining the geological data regarding the mine workings and the surface, and properly recording the same on plans, sections, and models; the outlining of prospect work, and the assisting of the mining superintendents in planning the development of mineable ground; making estimates of ore, and plans, sections, and models such as may be advisable to show the position and relations of the orebodies; also making reports on prospect and development work, on sampling, and on any work supervised by the geological department.

Special work comprises the examination of properties offered for sale. Many large corporations have a separate exploration department, in charge of an examining engineer, to attend to this work.

An organization scheme for the geological department follows:



ASSAYING AND SAMPLING. The assaying of samples from the mine should be done preferably in a building separate from the smelter and mill assay-office, and directly under the charge of the head sampler. A two-room laboratory with a crew of two or three assayers and an office-boy can handle ordinarily all the work of mines producing 5000 tons per day from underground mining.[1]

It is not necessary that the assayer or his assistants be chemists, but they must be thoroughly efficient and quick in making determinations of copper by standard methods. The colorimetric method or 'slop' cyanide method can be used for grab-samples, but the iodide or the electrolytic method should be used for channel-samples and drill-samples. The permanganate method is also used, and is preferred by some chemists. Assays are reported to 0.1% copper; reporting to hundredths is not necessary, and renders sample-maps less convenient for use.

A good sample-mill is necessary. It should have a capacity sufficient for the greatest amount of work expected, and should be so designed as to permit of enlargement at minimum expense.[2] Work is expedited by placing the sample-mill, the mine assay-office, the sampling, geological, and engineering offices close to each other and close to the principal mine-openings.

For the sake of accuracy, all sampling in the mine should be done by trained samplers who have no other work to do. However, all shift-bosses and foremen should have the privilege of taking as many special samples as they desire. When both stoping and development are proceeding normally, the shift-bosses should have plenty to do without sampling; to make them do sampling of any kind leads to dissatisfaction or poor work. Sampling by trammers is too inaccurate. In certain cases where development work only is being done, shift-bosses can take grab-samples at the headings, and so save the expense of a sampler.

Sampling of development work may be done roughly by the grab-sampling of rock-piles or the sampling of new exposures with a geological hammer; but sampling for permanent record should be done by cutting channels with hammer and moil, or by boring holes with a stoper and by using the drillings as a sample. Preference between grab-sampling and pick-sampling is a matter of personal choice; I prefer grab-sampling because it is faster and probably more accurate.

Channel-samples have been taken by hand on all the work of which I have had charge, but our experiments and those of the Arizona Copper Co. and of the Burro Mountain branch of the Phelps Dodge Corporation indicate that an air-hammer may be devised to do this work with a saving in cost of 25 to 50% over hand-work. The result will be neater in appearance, and probably more accurate.

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[1] See 'Preparing and Recording Samples in Assay Laboratories', by Louis D. Huntoon, Trans. A. I. M. E., XL, 747.

[2] For information regarding sample-mills see Trans. A. I. M. E., XL, 747; and Univ. of Montana Bulletin No. 3, March 1920.

Sampling with a stoper is more satisfactory than channel-sampling in at least two cases: first, when sampling workings that have been open long enough to contain an important amount of soluble copper[3]; second, in sampling the sides of stopes where veins, stringers, or mineralized slips are parallel to the sides of the stope. A factor in favor of drill-sampling is the possibility of unconscious salting in channel-sampling by knocking pieces of rich ore into the sample.

When sampling workings in mines in which soluble copper was noticeable, we conducted experiments to determine, first, if there had been a migration of copper from the inside of the rock to the exposed faces, resulting in an increase of total copper in the samples; second, to determine the relation of the copper in soluble form on the exposed face with that in the rock at various depths.

Experiments were conducted in several places by selecting 100-ft. blocks along drifts through sericitized and fractured monzonite-porphyry containing chalcocite disseminated in grains and in small stringers. The walls were cleaned with a wire-brush and channel-sampled carefully. Then six-foot holes were drilled at regular intervals, and separate samples were taken of the first two feet, the second two feet, and the third two feet of each hole. All samples were assayed for total and soluble copper. In one mine two experiments were performed. The channel-sampling was done when the drifts were new, about five years before the experiment, and had been checked by a thoroughly satisfactory mill-test. These results were used for comparison. The conclusion reached was that no appreciable migration of copper had occurred and that the ratio of soluble to total copper decreased with the distance from the exposed face to a point from three to four feet deep, where the normal or average soluble-copper content of the rock was reached. The ratio of soluble to total copper was two or more times as great in the first two feet of drill-hole as it was in the third two feet. The amount of copper in a soluble form depends on several factors and the depth of holes necessary to properly sample old workings for soluble copper would have to be determined by experiment in each case. Short cross-cuts or raises run into the orebody and sampled while fresh would probably be the best procedure, in case soluble copper was an important factor.

CHANNEL-SAMPLING. Before channel-sampling is begun the walls and roof should be cleaned with a wire-brush and all loose material removed. The canvas should be placed carefully to catch all the sample. Veins that are three inches or more in width should be sampled separately from the wall-rock, several cuts from different portions of the vein being combined, the average width of the vein being noted on the ticket.

It is advisable to have the men divided into gangs of six or eight, each under the immediate supervision of a jigger boss who fills out the sample-ticket, looks after supplies, and oversees the work. Form No. 7 shows a satisfactory sample-ticket. Those marked 'original' are placed above the sample in the neck of the sack and secured from damage by a few wraps of cord both below and above the ticket. The duplicate tickets are turned into the sample-office by the jigger boss. At times certain sample returns are desired ahead of all others; colored blank shipping-tags are attached outside the sack on such samples.

Within ordinary limits the size of the cut does not affect the accuracy. Experiments proved that as good results could be obtained from channels 2½ in. wide and 1 in. deep as from larger channels up to 10 in. wide by 1 in. deep. However, owing to the difficulty of obtaining good samples from narrow deep cuts, I prefer a width of 4 in. and a depth of ¾ inch.

An experienced man should average 20 linear feet per day of such channeling in ordinary (not silicified) porphyry ore; 10 linear feet, if cut horizontally in the side of a cross-cut constitutes one sample. The jigger boss and samplers are provided with a piece of ¾-in. board 4 in. long to measure the cut. The channels are of uniform size; all should cut the predominant structure at right angles; however, in the kind of orebody being considered, most of the channeling can be done horizontally in one side of the drift. In some mines the channels are cut in both sides of the drifts, but unless some extraordinary circumstance is involved, this is unnecessary. In one large mine the sampling was done in both sides of the drifts; upon comparison, it was found that, on about 30,000 linear feet of drifts, one side averaged 1.86% copper, the other side, 1.92% copper. The difference of 0.03% between the average grade and the grade of either side did not justify the expense of cutting the extra samples. On small sections, say, in any particular 100 ft., the difference might appear greater, but in larger sections the differences diminish.

It is practically impossible to tell the error in the results of channel or groove sampling that appears to have been carelessly done. A few examples will illustrate this:

(1) An orebody consisting of stringers and copper-bearing veins from $\frac{1}{16}$ in. to 18 in. wide through sericitized and kaolinized porphyry had been sampled by cutting rough grooves ⅛ in. to ¾ in. deep and 1½ to 2½ in. wide. New sampling was done with great care. The result of the old sampling was 1.96%, of the new sampling, 1.85% copper. (2) An orebody consisted of stringers of chalcocite and disseminated chalcocite through a sericitized and fairly firm porphyry, which in places was silicified and extremely hard. The old sampling by cutting grooves ⅛ to ½ in. deep and 1½ to 3½ in. wide averaged 1.68%; the new channel sampling averages 1.64% copper. (3) An orebody similar to No. 2 was sampled by cutting grooves ¼ to 1 in. deep and 5 in. wide. The old sampling showed 2.08%; the new, 1.80% copper.

With careful sampling, one set of channels should agree with another in the vicinity. The lower the grade of the material sampled and the larger the lode-area in-

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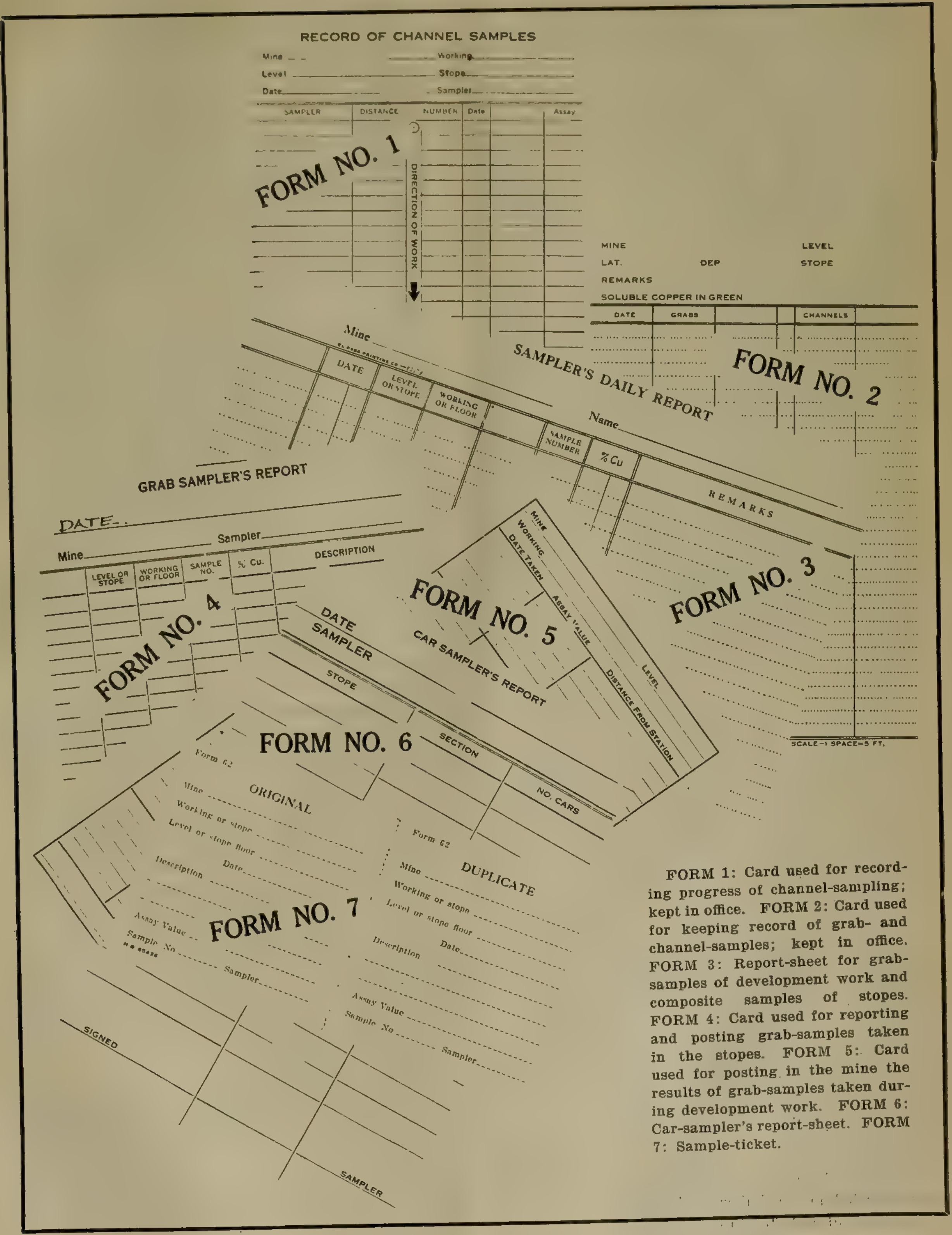
[3] The term soluble copper as here used means the copper dissolved by keeping the assay-pulp in a 4% solution of H_2SO_4 at the boiling-point for three minutes.



RECORD OF CHANNEL SAMPLES

Mine ___ Working ___

Level ___ Stope ___

Date ___ Sampler ___

SAMPLER	DISTANCE	NUMBER	Date	Assay

DIRECTION OF WORK

FORM NO. 1

MINE LEVEL

LAT. DEP STOPE

REMARKS

SOLUBLE COPPER IN GREEN

DATE	GRABS	CHANNELS

SCALE—1 SPACE—5 FT.

FORM NO. 2

SAMPLER'S DAILY REPORT

Mine ___

Name ___

DATE	LEVEL OR STOPE	WORKING OR FLOOR	SAMPLE NUMBER	% Cu	REMARKS

FORM NO. 3

GRAB SAMPLER'S REPORT

DATE ___

Mine ___ Sampler ___

LEVEL OR STOPE	WORKING OR FLOOR	SAMPLE NO.	% Cu.	DESCRIPTION

FORM NO. 4

MINE	WORKING	DATE TAKEN	ASSAY VALUE	LEVEL	DISTANCE FROM STATION

FORM NO. 5

CAR SAMPLER'S REPORT

DATE

SAMPLER

STOPE	SECTION	NO. CARS

FORM NO. 6

Form 62 ORIGINAL

Mine ___

Working or stope ___

Level or stope floor ___

Description ___ Date ___

Assay Value ___

Sample No ___ Sampler ___

Form 62 DUPLICATE

Mine ___

Working or stope ___

Level or stope floor ___

Description ___ Date ___

Assay Value ___

Sample No ___ Sampler ___

SIGNED

SAMPLER

FORM NO. 7

FORM 1: Card used for recording progress of channel-sampling; kept in office. FORM 2: Card used for keeping record of grab- and channel-samples; kept in office. FORM 3: Report-sheet for grab-samples of development work and composite samples of stopes. FORM 4: Card used for reporting and posting grab-samples taken in the stopes. FORM 5: Card used for posting in the mine the results of grab-samples taken during development work. FORM 6: Car-sampler's report-sheet. FORM 7: Sample-ticket.

cluded in the comparison, the smaller the difference will be, both in pounds of copper per ton of rock and in percentage of error. In the course of routine sampling the head sampler or geologist occasionally should pick out certain blocks of ground for re-sampling as a check on his own work. It is hard to say what check should be deemed satisfactory. Ordinary porphyry ore in 100-ft. block, assaying between 1 and 1.25%, should check within 0.05% copper; ore between 1.25 and 1.5% should check within 0.08%; material between 1.5 and 2% should check within 0.10%; 2 and 3% ore should probably check within 0.2% copper in 100-ft. blocks. However, each geologist should determine the limits for his orebodies by trial.

Before a final estimate or extensive mining plans are made, the sampling-error of each important orebody should be ascertained by suitable mill-tests. If the material that comes from the development of a block is segregated as mined and then subjected to a mill-test the necessary data are obtained at little, if any, more expense than if special mill-tests are made after development is completed; in many respects the former plan is the better.

On low-grade material (say, 1.25% copper) in large blocks, it has been proved by an extensive series of mill-tests that channel-sampling may be done so that the result will be within 0.03% of the copper found by mill-tests. The rock in this case was monzonite-porphyry and fairly soft, the copper mainly as chalcocite disseminated in grains throughout the porphyry.

Ordinarily in making preliminary estimates from good channel-sampling on ore assaying from 1.5% to 2%, when no mill-tests have been made, I think from 8 to 10% should be deducted from the average as determined by sampling.

SAMPLING IN STOPES. When stopes are low-grade and the ore spotty, the difference between profit and loss may depend upon keeping a close control of the grade of ore that is broken. For this purpose, the most satisfactory system is to take grab-samples from the broken ore in the stopes, to sample the walls or roof by aid of moils or stoper-drills in special instances, and to take grab-samples from the mine-cars at the shaft before they are dumped into the ore-pocket.

In square-set stopes, in Mitchell-slice stopes, in flat-slice top-caving or brow-caving stopes, in inclined-slice stopes, and in any stope where timber-sets are used, the grab-sampler samples the muck piles, tacks on a convenient timber a ticket bearing the sample number only, and fills in on Form No. 4 (in duplicate), giving the stope number, floor, sample number, and description. When the sample-office has filled in the percentage of copper, the sampler writes the percentage on the ticket tacked to the timber, and also in its proper place upon a map, on a scale of 1 in. to 25 ft., which is kept near or in the stope for reference. In case there is doubt about an exposed face being 'ore', it is sampled by moil or drill, and recorded on the timbers and on the map.

In slice-cut-and-fill stopes sampling is done in the same way, but, as there are few timbers or none, the map record is more important. In shrinkage stopes or in room-and-pillar stopes no grab-sampling is done, but channel-cuts or a row of stoper-holes are made horizontally across the side and at vertical intervals of five or ten feet. The assays are shown on vertical sections kept in the stope. In sub-level block-caving stopes all development should be grab-sampled, and enough channeling done to determine the grade of each section. This sampling in the stopes tells the mine-boss the grade of the material from each set. In case he is uncertain whether the ground ahead will be 'ore', the sampler is put to work immediately, and the boss gets a return before any error is made. The underground maps are used in compiling a set of office maps, from which estimates of reserves are made. Also they are of benefit in planning the stoping operations.

The minimum grade of material to be mined from each stope is determined by the superintendent of the mining department, who informs the chief geologist and mine foreman, respectively. The results are checked by general stope-samples taken at the collar of the shafts. A sampler is stationed on each haulage-level at the ore-pockets and grabs a sample from each car before it is dumped. Cars from different stopes are denoted by sticks carrying the stope-number placed in the cars at the chutes by the brakeman. Form No. 6 is filled out and turned in by the car-samplers.

The composite grade of each stope is known by noon of the following day, or sooner, and the foremen are notified to act accordingly. At one group of mines, by careful work and by the observance of strict orders to hoist no waste, the grade of ore was raised from about 1.75% to 2.25%, with a consequent saving in dollars.

An experiment was performed to determine what size of rock best represented the grade of the run of mine, and it was found that material retained on a screen with half-inch openings was the most nearly correct. However, when loaded cars containing broken material ranging from dust to lumps 12 in. or more in diameter are hauled from the chutes to a shaft, almost all the small pieces are found to be well below the top of the load; nearly all the samplers who are told to take a sample with a fork or punched scoop will be forced to use their hands as well. But the idea as to the proper size of pieces, of not getting too much fine or of selecting the best-looking rock, and of taking a representative sample from all over the load, will finally penetrate the intellect of even a foreign laborer if the sampler-boss keeps patting him on the back and if his job depends upon his taking a correct sample.

Sampling by car-men has proved a failure wherever I have seen it tried. Theoretically it is all right, practically the car-man considers his business is not sampling, and he won't learn to sample. When employing regular car-samplers, the errors tend to compensate; if the report for a day be in error, over a week or ten days the results will be fairly good, especially on low-grade porphyry ore. On oxidized or on high-grade sulphide ore this kind of sampling is discouraging. To show how errors compensate. I give the results of several months sampling of a porphyry mine: On 298,000 tons the car-samples gave 2.35%; the mill-headings gave 2.26%.

So many factors enter into this problem of car-sampling that about the only way the sampling error can be approximated is by trial. Once the results are fairly close, one has a pretty good chance of ascertaining who is 'running caves' and shooting 'easy to get' waste.

In drawing stopes, during block-caving or shrinkage, an engineer takes special note of the cars and watches the material as withdrawn, taking samples and closing the waste-chutes.[4]

A regular schedule of routing all samples from the point where they are taken in the mine to the sampling-mill must be worked out. Samples of water from the precipitation plant are best taken by attendants, but the geological department may help by reporting places in the mine or on the surface where water is going to waste. The geologists, particularly while going through old workings, should note the flow of water, and if it is wasting they should have it sampled.

Office Work of Sampling. In the office the recording of samples and the making of routine reports will occupy the full time of one or more men. The employment of new men on this work should be avoided; those who are good draftsmen and fast operators on calculating machines are desirable. Channel-samples are ticketed in the mine by the sampler-boss, and duplicate tickets are brought into the office at the end of each shift, when the boss enters, on a printed form, the number of samples taken by each man, counting back-samples as one and a third. From the duplicate tickets the cards (Form No. 1) are filled out, thus telling at a glance how far sampling has progressed in each working, and fixing responsibility for the work. The progress of sampling may also be shown on blue-prints by shading the sampled areas in pencil. This aids the head sampler in directing the work.

The assay-office returns the original channel-sample ticket with the assay recorded on it, and from this ticket the card (Form No. 2) is filled out, the place sampled being shown in the column to the right; the soluble-copper assay is written in green ink in the small column to the left. Soluble copper is determined on composites only. Cards (Forms No. 1 and 2) are filed vertically in card-index boxes, according to mines, levels, and workings numbers. Ruled cards without printed headings are used to preserve special data. The data are kept on cards instead of in books because of greater ease in filing. From the tickets or from the cards the channel-samples are placed on the assay-maps. Grab-samples are originally recorded on the maps in pencil, and later the marks are erased and the channel-samples entered in ink. Channel-samples are not posted in the mine, except the special samples taken in the stopes.

Grab-samples of waste broken in development or prospect headings are reported to the sample office on Form No. 4 and are posted on cards (Form No. 2), and assay-maps, and in the mine on Form No. 5 by the samplers. The grab-sampler's copy of this report (Form No. 4) has the assays placed on it by the sample office immediately after the assayer's report is received, so that the sampler may never be delayed in posting his returns. Grab-samples of stopes are returned from the assay-office on Form No. 4 and are placed on the maps and timbers in the mine by the sampler. At the end of each month, or as desired, the samplers' stope-maps (on a scale of 25 ft.) are brought into the office, where averages for the different workings are computed. Office maps of the stopes, on a scale of 25 ft., are kept, and on these are shown the areas of different grades of material as extracted. These maps (tracings) are used to guide the mining operations and to estimate the ore-reserves. They show the grade of material in such a way that waste and ore are made distinctive.

If if were not desirable to do selective mining, maps such as these would not be needed, and the sampling and map work would be simplified. Where selective mining is not attempted it suffices to keep an office record of the grade of each stope for the month as determined by car-sampling adjusted to mill-headings, and record this grade on tracings of the engineer's stope-maps, showing the work done each month. The sample-maps should correspond in scale to the engineer's maps of the same work. Standard sheets of tracing-cloth with the general title, co-ordinate lines, and border printed by machine will save time and make the drawings look better; they can then be filed easier. I prefer the flat filing of maps. The mines should be divided into sections so as to be not over 30 by 30 in. on the scale of the base map—50-ft. scale preferred—and each assay-sheet is made to cover one section. Sheets can then be filed by sections and elevations. The system of filing all engineering and geologic data should be thoroughly worked out and be capable of expansion without becoming cumbersome. The numbering of sections (1, 2, 3, 4, etc.) seems better to me than a system in which a section would be called 3E, 3D, or 3C. A key-map, to show the sections and a composite of the mine workings, should be kept near the files for reference.

The car-samples are tabulated in the sample office, and averages are figured over any period desired. Generally reports of weekly and monthly averages for each stope are turned in, as well as the daily reports. The geologists can keep informed concerning the development work by consulting the assay-cards or maps, but if the mine department wishes special tabulations of the grade to be placed in the superintendent's or manager's office this can be done by recording the grade of each heading daily on wall-sheets.

Copies of a report (Form No. 3), showing all the grab-samples, are sent to the mine superintendent, chief geologist, and to each mine foreman if desired. Special reports and plats, giving data on mine development and prospecting, are made from time to time. Maps of levels, on a 100-ft. scale, showing only the averages of samples by 50-ft. blocks or by breaks in the grade, are desirable for getting a general idea of the mines and for estimates of ore. These maps should be brought up to date at least once a month.

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[4] For a method of keeping track of this work, see A. I. M. E., LII, 381.

The above work gives the sampling office the following sources of information:

(1) Cards and maps of the channel-sampling of all development work.

(2) A record showing just what part of the work has been channel-sampled, whether the returns have been received or not, and who did each piece of sampling.

(3) A record of the amount of work per day of each sampler.

(4) Maps kept in the mine showing the grab-sampling of each set or round in the slice and square-set stopes.

(5) Same as (4), shown by tickets tacked on timbers.

(6) Office maps showing the grab-sampling of each stope-floor, the waste and ore being shown separately even in small quantities.

(7) Record of car-samples for each stope daily, giving a quick method of finding out which stopes are falling behind in grade.

(8) Daily record on cards of grab-samples from each development and prospect heading. This is posted immediately on receipt of assays, and is easier to use than maps. This record is also found on cards at each mine-heading.

(9) Record on vertical sections of the channel-sampling of each room-and-pillar stopes.

(10) Record of the sampling of all sub-caving, cut, and fill, and miscellaneous stopes on the office maps.

(11) Record on cards and vertical sections of the sampling of each raise, winze, and shaft.

(12) All the data are filed systematically for quick reference.

(To be Concluded)

The American Engineering Standards Committee has just completed arrangements by which co-operation with the standardizing bodies in other countries will be made more effective. In doing this it has followed the recommendations of the unofficial conference of the secretaries of the national standardizing bodies that was held in London in April 1921. In order that all standards shall be available to the industries of the various countries, it is planned that each national body will use the approved standards of the other bodies. The American Engineering Standards Committee (29 West 39th street, New York City) has available the publications of the standardizing bodies in Austria, Belgium, Canada, France, Germany, Great Britain, Holland, Sweden, and Switzerland. Hereafter the A. E. S. C. will exchange information regularly with the foreign bodies as to the status of work being undertaken. This information will be limited to the indication of the stage of development of the projects, it being left in each case to the various sectional committees and sponsor bodies to decide to what extent they desire to exchange technical memoranda or drafts of standards.

Ore Deposits of Cedar Mountain, Mineral County, Nevada

Cedar mountain, in western Nevada, contains the Simon silver-lead district, which is the chief centre of interest, and the Omco gold distdict, states Adolph Knopf in Bulletin 725-H, U. S. Geological Survey.

In 1919 large bodies of silver-bearing lead-zinc ore were discovered below an immense gossan that had been known since 1879 but had not been thoroughly prospected. A rush to the district took place and the country was staked over a radius of many miles. The area soon became known as the Simon district, from the name of the chief mine. The excitement quickly subsided, however, and by the summer of 1920 work was being done only at two places—the Simon mine, in which a large body of ore had been partly blocked out, and the Contact prospect.

The ore deposits are in the northern part of Cedar mountain. At Simon the rocks that compose the range are divided by a great transverse fault. North of the fault the range consists wholly of Tertiary rocks, mainly rhyolites and andesites; south of the fault it consists of Triassic rocks which have been intruded by grano-diorite and allied dikes.

The oldest rocks—those of Triassic age—are chiefly limestones. The volcanic rocks that occur with them in places were erupted contemporaneously with the deposition of the limestones, like the lavas that occur in the Triassic elsewhere in Nevada. The limestones and associated lavas and tuffs were intruded by grano-diorite at the end of the Jurassic or early in the Cretaceous period, and the silver-lead ores appear to have been formed as one of the consequences of that intrusion.

In Tertiary time, after erosion had progressed far enough partly to uncover the granite, volcanic activity set in and large volumes of rhyolite and andesite were erupted. Subsequently, approximately late in Miocene time, a great fresh-water lake was formed wherein were deposited the sandstones, shales, limestones, and other rocks of the Esmeralda formation. These lake beds lie on both flanks of Cedar mountain and have been folded and considerably faulted.

The ore deposits of main interest are the silver-bearing lead-zinc bodies at the Simon mine. They consist of galena and zinc-blende, commonly enclosed in a gangue of jasperoid, and have resulted from the replacement of the Triassic limestone adjoining an alaskite porphyry dike. These ores appear to be of late Jurassic or early Cretaceous age and to have been formed in connection with the intrusion of the grano-diorite and the associated dikes.

The gold-bearing deposits are quartz veins enclosed in the Tertiary lavas. The veins are of the well-known distinctive Tertiary type, wherein much of the quartz is pseudomorphic after lamellar calcite. The precious metal—probably the gold-silver alloy electrum—is so finely disseminated throughout the quartz as to be invisible, and sulphides are absent. Thus these veins contrast notably in appearance and content with the lead-silver ores.

Economics of the Rand

By F. Wartenweiler

*Basic progress in science is slow and occurs by reasoned stages. Many of us, engrossed in our routine tasks and having the responsibility of maintaining a high standard of efficiency, are, perhaps, barely cognizant of the slow development of the art until we pause to consider and review. It is then that evolution is revealed to us.

UNDERGROUND FEATURES. In dealing with the metallurgy of the Witwatersrand it is often taken for granted that the initial steps begin after the ore has been hoisted to the surface and delivered to the reduction department. On some mines this can be accepted as the starting-point for the beneficiation of the ore. On others, however, natural chemical processes, which affect the subsequent treatment, begin in the stope, the ore-pass, and the pump-sump, and it is due to the recognition of this fundamental fact that one large group has begun ore-treatment underground, and has thus extended the responsibility and usefulness of the chemist and metallurgist. I allude to the chemical control of neutralization of acid mine-water by means of lime, the settlement of sludge, its subsequent disposal, and the maintenance of a favorable composition of water for re-use in allaying dust, in which there are pitfalls unseen except by the trained chemist. The precipitation, from a supersaturated mine-water, of the calcium sulphate formed in neutralizing, or its prevention by adequate dilution, cannot be ignored without the payment of the penalty—scale in pipes or the purchase of an expensive precipitant.

Precise chemical control appeals to the economist and mine-owner as a means of saving tons of steel and other material used underground, not to mention that of cyanide at the surface-plant. As an example the experience of one mine may be mentioned where, by careful control, cyanide consumption has been lowered from 0.28 lb. to 0.18 lb. per ton of ore treated.

Acidity in mine-water has been known to be sufficiently high in some old workings to cause blisters. We have also heard of miners who have suffered from burns because of the strong alkalinity of an accumulation of milk-of-lime in some back-water underground. The one points to the moral of the usefulness of information on the degree of acidity; the other, of wastefulness of lime when not applied under precise control or at the most effective place.

The practice of underground support by means of ore-packs is well known. In view of the chemical and physical alterations taking place in these packs the question arises whether such a method of mining affects the subsequent extraction of gold, and to what extent. No satisfying answer has been forthcoming, perhaps for lack of opportunity to make a definite test.

Sand-filling by which residue is returned to its place of origin—the stope—has been adopted widely; in some cases the sand has found its way back to the reduction plant in small quantities, particularly on outcrop mines, where ground movements and consequent breaking of barricades has taken place. The incidence of this acid material in the extraction of gold from the clean current ore is noted by reduction men to be adverse.

CRUSHING AND SORTING operations are so closely related, locally, as to be dealt with under one heading. This is such an important and comprehensive subject that it could easily form the sole basis of a paper. Interest seems to have lagged of late years. Is it because the existing plants are considered capable of fulfilling all requirements from the point of view of efficient crushing, sorting, and low cost of operation? Not until you make a close study of various types of plants now in operation are you impressed with the variety of objectives originally affecting the design of each.

The early designers, in the pre-conveyor belt days, built skyward, and, in conjunction with rotary sorting-tables, they often employed crushers at the highest point of the structure for cracking large rock prior to sorting. Many of these old plants continue in operation, and excellent work can be done. Sorting to the extent of 16% has been carried out in a station of this type by picking out the valueless banket in addition to the usual quartzite and dike waste.

We then come to the type of station employing conveyor-belts, and in which sorting and crushing in two stages is practised. Although the high proportion of sorting possible with such a design has fulfilled the most sanguine expectations in this direction, lack of native labor and other economic factors have usually retired it in favor of the simple straight-line design now found in our later plants. Such a station, with trommel-washing or with washing on a sharply inclined portion of the sorting-belt, lends itself, by reason of simplicity, to minimum capital and running expenditure.

One of the latest plants provides for the washing of all the ore coming from the mine, including the grizzley by-pass, called unsortable fine, which comprises as high a proportion of the ore milled as 40%. This is an innovation. The object is three-fold: first, to avoid sending slushy fine to the stamp-mill bin, the moisture from which leads to decay of timber and battery foundations: It rusts steel, and indirectly causes steel and cam-shaft breakage through irregular feed; second, all material passing a ½-in. punched screen is sent to its most efficient grinding machine, the tube-mill; third, the chemical mo-

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*Abstract of the address of the President of the Chemical, Metallurgical and Mining Society of South Africa.

tive, which allows thorough neutralization with lime-water of that portion of the ore that benefits by such treatment. It is of interest to note that as much as 15% of the ore milled is by-passed by this method.

With the realization of the expense of conveyor-belt wear and tear, the re-adoption of preliminary cracking of large rock is being considered in order to reduce incidental rough usage. Also washing-trommels stationed at the primary bins are favored for the elimination of the slushy fine, so that no belt need become a conveyor of a material that, having the property of mobility, is transported preferably by the impulse of a modern centrifugal pump. The sorting percentage becomes a function of the number of native sorters and the amount of waste present; this depends often on underground conditions and the reef formation. It is, perhaps, not always realized that many mines, owing to peculiarities in ore-channel, present individual problems in sorting that must be studied separately if this important part of ore-dressing is to be conducted on an intelligent and scientific basis.

STAMPING. The Californian stamp and its first cousin, the Nissen, have survived. There are those in our Society who hold the view that these will continue to crush Witwatersrand banket at least during our generation. Others feel that improved modern ball- or tube-mill development will seal their doom as an economical crusher in stages. The question is extensive in its bearings and is most important. Working experiments have been conducted recently on this point at one of the Far East mines.† To what extent the crusher and the tube-mill can encroach economically on the domain of the stamps, squeezing it out of existence, is a point for careful trial on an extended working scale.

It is here that the heavy gravity stamp has reached its highest state of perfection. The 1850-lb. Californian stamp at the Government Areas mill crushes 28.5 tons per 24 hours through a screen-aperture 0.625 in. square, while at New Modderfontein the 1900-lb. Nissen crushes 31.5 tons through a somewhat finer screen. If you are statistically inclined, the size and power of the stamp-mills on the Witwatersrand may be illustrated in various ways. For example: if all the 10-stamp batteries were placed adjoining they would make one continuous line extending for a distance of two and a half miles. If all the stamps were combined into one the blow of this mammoth stamp would be equivalent to a weight of 5200 tons dropping eight inches 99 times per minute.

Since the early Californian days the roar of stamp-mills has followed the axe of the pioneer in many parts of the world, and whatever may be their ultimate fate, to those of us who have spent many working-hours in a stamp-mill, the surf-like roar of its many batteries will remain impressed in our minds as symbolical of the restlessness and untiring energy of the gold-mining industry.

TUBE-MILLING. This practice nowadays appears to be rather one of detail. The tube-mills are called upon to grind to a finer degree of comminution than ever, one plant delivering a final product of which 90% passes 90-mesh. Good practice now demands a coarse feed, the new installations feeding ½-in. maximum size. In trials we have experimented with feed as coarse as that fed to stamps.

Scoop-discharges of varying effective lift with screen-openings of ample size to permit free discharge of the spent pebble are generally adopted except on old plants where the use of small motors does not permit the resulting high-power load. Shell-liners of the Osborn and El Oro type find general favor. These are keyed and require no holding-bolts. End liners are either cast or forged from discarded stamp-mill shoe-shanks or dies.

No recent data have been published of the merits of the short 6 ft. diam. by 16 ft. long tube in comparison with the orthodox size, 5½ ft. diam. by 22 ft. There are also a few 6 ft. diam. by 20 ft. mills in operation whose performances have yet to be compared.

Since the trials of the Giesecke ball-mills, to my knowledge, no further attempts have been made with steel balls. How effective a modern mill with balls of large diameter would be on the banket leads to interesting speculation. It should be recognized that this ore is one of the hardest and most abrasive known, and a steel ball that readily crushes porphyry ore may prove impotent on banket. There are undoubtedly degrees of hardness and toughness in the ore delivered to reduction plants scattered from Randfontein to Springs, and it may be no idle speculation to look forward to the discovery of an ore that will lend itself to a change in the grinding medium.

AMALGAMATION. Like taxes, the ancient amalgamation recovery method is still with us, and is responsible for from 40 to 70% of the assay-value of our mill-feed. While, with our system of classification, preferential amalgamation really takes place in practice, the question arises whether this could not be intensified and mechanical contrivance and concentration called in. The day of the non-amalgamating plant and the extraction of all recoverable gold by cyaniding may arrive. In fact, one mine has committed itself to that method, and elsewhere working trials having this in view have been projected and are only awaiting opportunity and adequate support. Undoubtedly the knowledge that visible coarse gold is found in certain portions of the richer mines has acted as a deterrent with responsible officials. Aside from any technical advantage, the introduction of a method that reduces or eliminates the risk of mercury poisoning would appeal to a humane spirit.

CYANIDING AND CHEMICAL TREATMENT. No fundamental changes have been effected in cyaniding in the last few years. Considerable experimentation, however, has been conducted quietly, resulting in gains here and there. The practicability of collecting sand and its treatment in the same vat is well established at one of the most recently erected plants. Careful classification is a corollary. The importance of close classification and the advantage of fine grinding of the pyritic portion of the ore is receiving constant attention by reduction officials.

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†The reference is to mines at the eastern end of the Main Reef series.

Cyanide solution strengths have been on the down grade, and with the adoption of de-aeration of solutions prior to precipitation they will continue on this course. The saving of cyanide and zinc resulting from this constant pressure of experimentation with lower and lower cyanide strengths and with improved precipitation technique has been considerable. On one group of mines alone it has amounted to £250,000 in five years.

Precipitation has received due attention, and on some of the plants a feed-rate per diem of 2.3 tons of slime solution per cubic foot of zinc shaving in extractor-boxes is current practice. The Chamber of Mines financed extensive trials on the de-aeration of cyanide solution, and, resulting from these, mechanical de-aeration has been decided on at five reduction works, of which three installations are in operation. The expectation of direct and indirect economy promises to be fulfilled. Interesting details, it is hoped, will be brought forward for discussion this year.

Precipitation research has not been lacking within recent years; the margin of possible improvement, however, is small, and any new process calling for a new installation with heavy capital expenditure is severely handicapped by economic considerations.

Oxidizing reagents, by reason of rapidity of reaction and expense, do not find favor. Their effect is evanescent and apt to be harmful. The economical and satisfactory supply of oxygen continues to be derived from the air. Experience with de-aeration has taught us how readily air dissolves in solution and how watchful one must be to prevent this at certain stages of the cyanide process.

Vacuum filters are now accepted by the majority as standard slime-washing equipment for new plants. The washing is controllable, depending so much less than the decantation process on ratio of dilution and on the weather. Many installations maintain a consistent daily capacity rate of 3.5 tons of dry slime per leaf.

SMELTING AND REFINING. No innovations have been introduced in recent years into refining and smelting on the individual mines. The large refinery erected near Germiston by the Chamber of Mines for the purpose of refining the gold output of the Witwatersrand by the chlorine process is about to operate and will no doubt offer an interesting study to technical men. We hope to be favored with a description of its technology in due course.

Acid treatment of the gold-zinc slime from precipitation remains general practice, although with the precepitation improvements referred to this will possible be discontinued. Subsequent calcination and pot smelting or reverberatory lead smelting is the practice according to preference or works convenience. Small blast-furnaces are found useful for smelting by-products on the larger mines. For others the Witwatersrand Co-operative Smelter, a most excellent institution, fills all requirements. The treatment by cyanide of the black sand or pyritic by-products from amalgamation has received attention by many of our members and is well established. Schemes for utilizing the zinc sulphate liquor, now wasted, are ingenious and have undoubted merit, and I confidently look forward to an economic utilization of this liquor.

BASE METALS. During the present slump, base metals have been neglected. Not many miles from here a silver-lead smelter was blown in recently, that of the Transvaal Silver & Base Metals Co., at Argent. Tin has been smelted for several years at the mines situated up-country; copper metallurgy has been practised at Messina and the Falcon mine. Great developments are from all accounts taking place at the Congo copper mines. Rhodesia boasts of a large working chrome-iron deposit. Pyrite is being mined in the Lydenburg district, and, after concentration, is sold to chemical plants for its sulphur and gold. Considerable asbestos and mica are mined in South Africa, yet the method of selection and preparation for the foreign market, or in other words, the ore-dressing, remains a sealed book to most of us.

RESEARCH. Our Society has been noted for the presentation of original papers describing the results of successful constructive researches in pure science. How often negative answers are the reward of long patient searching in laboratory and works many are aware. Such work, although valuable at times in a negative sense, is quietly buried in files.

Research is a tender plant and requires a congenial atmosphere. Inspiration and concentration are its companions. Surroundings, nature of colleagues, past successes, praise, sometimes condemnation, are also forces which circulate its life blood. Research is said to be the occupation of a gentleman. It is a noble calling and should, in theory, be unhampered by financial considerations. The scientist so engaged must have imagination, originality, and knowledge; his mind should be free from all outside worries in order to be receptive of the smallest sign leading to actual discovery. These often hinge on the veriest trifle or on accident. However, if Goodyear, the inventor of vulcanizing rubber, had not been engaged in rubber research for years, he would in all probability not have observed the peculiar effect of heat on a mixture of rubber and sulphur, fallen, by accident, on his stove and thus producing the first vulcanized rubber.

Research is often far-reaching in its indirect effect. A member of our Council made public at one of the meetings a short method of determination of oxygen in cyanide solution. This method has supplied a means of obtaining information about our cyanide-plant solutions which has proved both instructive and useful.

Perhaps I may be permitted to indulge in a personal reminiscence while on this subject. When engaged in the early days of cyaniding on the economic solution of the Homestake cyanide problem, to our dismay the sand charges refused to yield more than 50% of the gold. Not until the discovery was made that, although well drained, most of the extraction was taking place in the top half of the charge, was any progress made. The chief then made one of those correct deductions, characteristic of his well-trained mind, that owing to the presence of a strong oxygen absorbing constituent in the ore the bottom half of the charge suffered under a deficiency of that necessary element; and that, to overcome the then prohibitive expense of double treatment, oxygen might be supplied by blowing air through the sand from beneath the filter-mat. This proved to be sound and spelled success to the cyanide treatment of Homestake tailing. Although apparently a small point, in its result it has been of the utmost practical value.

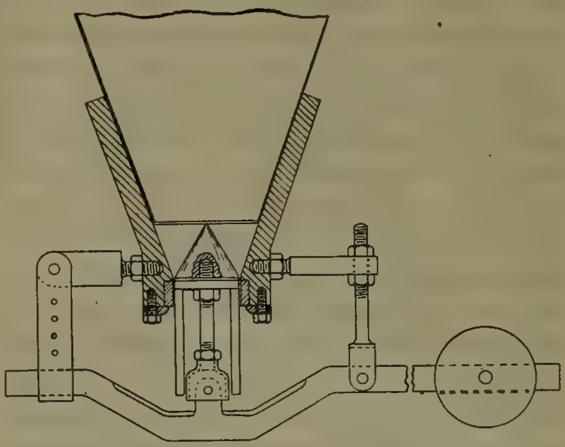
As a class, scientists and technical men are inarticulate, and although of no mean mentality and accustomed to the acceptance of responsibility, carry but little power and inject no force into public life. Perhaps studious inclination and political disinclination are at the root of it. It is certainly to our disadvantage in these days when shibboleths by phrasemongers sway and govern the world. Perhaps we prefer not to mix in the poison gas of public affairs. However that may be, let us hope that our abstinence will never lead to the extinction of civilization. It is held by thoughtful men that we have a public duty to perform and a responsibility to accept. As men trained in natural science and disciplined in the hard school of facts we are expected to possess that conception of duty and love of truth that leads to high ideals. And one of these may well be the stimulation of greater intellectual and creative interest in the everyday life of those performing the routine work of the industries and processes we have the honor to organize and direct. Our leadership should be an inspiration to those engaged in the wide field of applied science.

We are expected by the country to blaze the trail of scientific and technical progress, not only by transplanting the knowledge and the known processes of technology to these shores, but also to create new methods and to discover fresh resources.

ALUMINUM CASTINGS are somewhat difficult to weld when broken, owing to the liability of the part drawing out of shape while cooling, or cracking owing to the locked-up stresses, states the 'Mechanical World'. If the part changes shape it will be impossible to re-assemble it, and if held rigidly to a steel frame while cooling, so as to maintain the original form, there is danger of cracking. One of the most effective materials for insulating preheated aluminum castings and preventing cracks while cooling is dry soft-wood sawdust. The sawdust should be used liberally, covering the welded casting to a depth of, say, 2 in. If dry, it is an excellent insulator; if the casting is hot it is likely to take fire and smoulder slowly, thus extending the cooling period considerably. An aluminum casting so treated will be so well annealed when cooled that it can be bent without fracture. In this connection it is of interest to note a method employed by coppersmiths to anneal large copper and brass sheets, and keep them flat, described in 'Autogenous Welding'. The same method is used for aluminum and monel-metal sheets. After being heated the sheets are laid between dry pine boards and left to cool. The boards are excellent heat insulators, and as the wood chars and smoulders for a time, the slow combustion helps to maintain the heat. The sheets lose their heat slowly; and so it is that, when finally cool, they are soft and easily bent.

Regulator for Conical Classifier

A novel type of regulator for conical classifiers, illustrated herewith, is described by H. Brazier in a recent issue of the 'Journal' of the Chemical, Metallurgical, and Mining Society of South Africa. The device has been in operation at the Ferreira Deep tube-mill plant since May 1919 and has proved satisfactory. An even feed to the mill is ensured by means of a counter-weight, which is adjustable, and which serves to keep the valve opened and balanced against the weight of pulp when flow is normal. When the pulp becomes thin, the velocity of flow is raised. The increase in friction and pressure causes a throttling action, which automatically reduces the amount to normal proportions. Maintenance costs are said to be extremely low.


AUTOMATIC REGULATOR FOR CONICAL CLASSIFIER

DURING 1920 China imported more than double the amount of silver imported during 1919, in which year the imports were more than double the amount imported in any previous year during the ten-year period from 1911 to 1920, states a consular report. The 1919 imports of silver amounted to 62,093,707 taels ($84,385,347), compared with imports of 126,394,388 taels ($155,465,097) in 1920. In the latter year 33,715,410 taels ($41,469,954) of silver was exported. Gold imports for 1920 were likewise large, only exceeded during the ten-year period by the 1919 imports. These imports amounted in value to 50,966,880 haikwan taels ($62,679,262) in 1920, as compared with 51,078,643 taels ($69,415,875) in 1919. On the other hand, a large increase was recorded in the value of gold exported from China, which was valued at 68,469,360 haikwan taels ($82,217,212) in 1920, as against 9,896,429 taels ($13,449,247) in 1919.

Quicksilver Mining in China

*Quicksilver has been mined in the Toonyen prefecture, Kweichow province, South China, for several centuries. The land-owners claim that their ancestors were mining for quicksilver during the Ming Dynasty (1368-1644). Gunpowder was introduced for the first time as an explosive about the year 1870 by miners from Szechuan. Previously fire-setting and the hammer and gad were the only means of mining. The geological formation of the region is magnesian limestone, in horizontally stratified beds of several hundred feet in thickness. The mineralized zone is roughly three miles square. The quicksilver deposits are not continuous, and they are irregular in shape. The country is cut by canyons running in various directions, and it is noticeable that those deposits which are near the rim of the canyons are richer and more extensively worked than those occurring farther afield. The ore occurs: (1) as impregnation of well-defined beds of limestone; (2) along the joints, cracks, and planes of stratification; (3) in isolated bunches, nests or pockets, and in cavities that contain crystalline aggregates or well-developed crystals of cinnabar in the form of penetration twins of two rhombohedra, associated with quartz and calcite; (4) irregularly disseminated through a number of beds that have undergone, in most cases, considerable local disturbances. There are two varieties of cinnabar. One is of a bright and transparent red, the other of a dark, opaque red with which antimony is almost invariably associated in small quantities. The former is known as the red and the latter as the black cinnabar. Pyrite is absent. Native mercury is found associated with the antimonial ores. These deposits are similar to, and characteristic of, others in the districts of Beh-mahtung, Wuchuan, and Pachai.

The methods employed in mining and smelting are crude, and conform to no laws or regulations. About the time of Mr. Trythall's visit, mining regulations were issued by the imperial government, but were never enforced, nor was the slightest notice taken of them. In the mines known as private mines, which have been acquired by a company, the miners are required to sharpen their own drills before entering the mine, to drill and fire two 15-in. holes. They drill single-handed with 7-lb. hammers, a back-hole counting double. The drills, ¾-in. diameter, are of iron, pointed with steel at both ends. Other mines, described as public, are usually old workings that have been abandoned by companies as too poor, but still containing patches of ore sufficiently remunerative for individual miners, who are allowed to work them on payment of 600 cash (1s. 7d.) per month, known as 'hammer tax', to the local magistrate. The miners work on day's pay or on tribute. In the first case the hours worked amount at most to six; but every fifth day, being market- and pay-day, is regarded as a holiday, when they receive 400 cash (about 1s.). In addition to the wages they are supplied daily with two meals, consisting of boiled rice and vegetables, and on market days a small portion of pork. The meals cost roughly 50 cash or 1.6d. each. Thus a miner on day's pay earns, inclusive of his food, 130 cash (4.2d.) per day, and works at the outside 24 hours in five days. Overtime is paid on all holes drilled above two in a shift at the rate of 1.2d. per hole. The tributer supplies his own tools and explosives; he works without restriction on a piece of ground allotted to him by the company; his ore has to be taken to the company's smelter for treatment. He is paid for the quicksilver so produced at a rate lower than the prevailing market price; in addition, the buyer retains the mercury that remains in the furnace. All taxes are paid by the company to the officials and land-owners, whether the mines are worked on day's pay or on tribute. In the blasting operations, after the hole has been drilled to the required depth, a pricker is inserted and from two to three ounces of gunpowder is tamped around it with an iron rod, after which the hole is filled with clay or fine material nearly to the top. The pricker is then withdrawn carefully by twisting it with a pointed bar inserted in the eye of the pricker, and, in the space thus left, the fuse is introduced and a conical-shaped piece of paper attached to the end of the fuse; this, on being lit, smolders and acts as a time-fuse until it reaches the powder. The native fuse consists of a peculiar kind of brown paper, treated with nitre, and rolled tightly, enclosing a minute quantity of gunpowder. When finished it has the appearance of a piece of whip-cord. The timing is unreliable. Owing to the inferior quality of the gunpowder (which is made on the mines from ingredients obtained locally), the explosive force is small, only from 200 to 300 lb. of rock being dislodged per hole drilled.

No system of driving, sinking, or stoping is observed in the winning of the ore, the miner following a stringer on a mineralized band of ore, enlarging or reducing his working face as the mineral widens or pinches, resulting in a series of intricate workings. Timbering is unnecessary, as the ground is compact and holds well, even in the largest workings. The ore is transported from the working-face to the surface by means of baskets carrying 30 to 40 lb., fastened to the coolie's back by ropes that pass under the arms. In the low and narrow workings where it is impossible to stand upright, wooden boxes containing the ore are drawn along the floor by small boys, crawling, with a rope passing around the neck, down the stomach, between the legs, and attached to the box. On the ore reaching the surface, coolies, termed ore-pickers, cob and pick it; as much as possible of the barren rock is discarded. The large crystals of cinnabar are detached by means of a stout pointed wire. The ore is

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*Abstracted from a paper by F. Trythall, in Trans. Cornish Inst. Eng.

crushed on a large flat stone with hammers, to pass a ⅛-in. bamboo sieve; if the cinnabar is of the red variety, it is panned, the concentrate removed, and the tailing treated for quicksilver in the furnace retort. If the cinnabar is black, the panning is dispensed with, and the whole is put direct into the furnace.

During the winter months, when agricultural labor is more or less at a standstill, numbers of persons turn their attention to the working-over of the old dumps, and may be seen wending their way to the dumps at all hours, armed with a basket, hammer and rake, and sometimes a lamp, to enter the abandoned mines, returning with perhaps 10 to 15 lb. of picked ore containing 1 to 2% quicksilver. This ore is sold to the owners of private furnaces, of which there are a number scattered about the district. Pumping is a minor item, from the fact that the deposits are not deep-seated; the deeply-carved and fissured country does not permit of the accumulation of large quantities of water, which would prevent the natives from carrying out their primtive modes of mining. Where water accumulates in sufficient quantities to check operations, a bamboo or wooden chain-pump is installed, similar to those used for irrigation purposes; if it proves inadequate, the workings affected are abandoned until the water recedes. Ventilation is also a question which does not worry the Chinese miner. The imperfect combustion of the explosive, the smoke arising from the oil lamps, the filthy habits of the miners themselves, and the fact that many live in the mine for fear of having their rich ore stolen, all make the air foul; often, on entering a mine, it is almost impossible to see how many are at work or what is being done. The miners will submit to all these discomforts and dangers to health rather than do work that would involve expenditure without direct remuneration.

The furnaces, built in pairs, are 2 ft. 6 in. diam. and 1 ft. 6 in. high. Each consists of a cooking-pan, which serves as a receptable for the ore, resting on a round fireplace made of unburnt brick, on which is placed a similar pan inverted, with a 12-in. hole in its centre. On this is built a collar of clay, 12 in. high, strengthened by a plaited bamboo network, extending a few inches above the clay collar, serving as a support to the upper pan. The top of the clay collar is grooved in the centre, and a third pan, with a 12-in. diam. hole, rests on its inner rim, and this, being covered by an earthenware pot that acts as a condenser, an annular space is formed between the groove, the lower part of the top pan, and the inner side of the bamboo network. Three holes ¾ in. diam. are pierced through the rim of clay on which the topmost pan rests, and are known as percentage holes, inclining toward the centre of the furnace. The amount of quicksilver collected in this annular space depends on the inclination of the percentage holes, increasing in quantity as the angle of inclination increases. The earthenware pot or condenser is luted with fine residues and the bamboo network is lined with clay. Wood-fuel is used for heating purposes. The usual charge for one furnace is 50 lb. of ore. The quicksilver vapors condense in the annular space and earthenware pot, which is changed at intervals until the ore is exhausted, when the residue is withdrawn by means of a shovel the blade of which is at right angles to its handle, and replaced by another charge. While the condenser is being changed, the ore in the pan is stirred with a wooden pole, the fumes escaping during the operation. The condenser becomes coated with minute globules of quicksilver; these on removal are run together by rubbing the surface with a rag, forming a pool at the bottom of the pot. The losses, as far as can be estimated, vary between 30% and 40% of the total quicksilver. The amount collected in the condenser naturally depends on the richness of the ore treated, and sometimes as much as a 'catty' (1.3 lb.) is recovered. The metal is poured into bamboo flasks and eventually transported to the river-ports in pigs' bladders. The residue, especially in the case of rich ores, which still contains imperfectly burnt ore, is ground by hand, sluiced, and the concentrate again retorted.

In addition to the furnaces at work near the mines, considerable numbers are owned by individuals who carry on custom smelting, receiving in payment the quicksilver collected in the annular space through the percentage holes. The ore treated in these furnaces is obtained from the mines or from the dumps, and not infrequently by theft. The owners of private mines have furnaces for rich ore, and others for poor ore; if the miner strikes a rich pocket, the ore is treated in the rich-ore furnaces, the percentage holes being so inclined that the owner of the furnace receives about 40% of the total distillate as his share. This is an established custom to which the miners willingly conform.

An apparatus for the settlement of slime has been developed and patented by T. Steen. It consists of a shallow cylindrical tank with a deep conical bottom provided with an outlet tube. The tank is filled with the pulp, and a flat plate with an outline corresponding to that of the tank and having a specific pressure corresponding to the density and inner friction of the thick slime, is placed on the top of the liquid, through which it sinks to a depth where its pressure equals the upward pressure of the slime, thus forming a protecting cover to the layer of settled slime, at the same time leaving an annular opening between its periphery and the walls of the cone. On opening the cock at the bottom of the cone the hydrostatic pressure at first prevents the slime under the plate from being drawn off until that between the edges of the plate and the walls and the small amount of thinner slime above the plate has been removed, after which the level of the thicker slime is forced down until the plate fits the cone completely, when the flow of pulp stops.

During five recent and consecutive years, the losses from fire in California averaged $10,842,774 per annum, an amount that had it been saved instead of wasted would have sufficed for the building of nearly 11,000 homes at a cost of $5000 apiece. So much of the loss from fire is preventable that a more intensive campaign of education would appear to be justified.

The Mining of Oil-Shale in Colorado

By R. L. Chase

INTRODUCTORY. It is well at the end of a year to look back and see what has been accomplished in a constructive way, and especially is this true of a new and struggling industry such as that of oil-shale mining. This article will deal only with the Colorado shale-fields, which have attracted more attention than any others in this country. It may be well to mention here, however, that deposits of shale are world-wide.

The shale-lands of Colorado were located first as 160-acre placer claims, largely by local ranchers and other residents. Since that time the tendency has been for companies to consolidate the claims into large holdings, and by far the greater part of the work at present is to satisfy the annual assessment of $100 on each claim and carrying the claims to patent. Assessment work in the shale-fields is different from such work on metal-mining claims. On the latter, unless an active adverse claimant exists, the assessment work is often neglected, or only a small part of it is performed. On shale-lands, however, the Government became an active claimant by the passage of the Leasing Bill on February 25, 1920, and the various acts and requirements of location and the assessment expenditures are examined carefully by the Land Office before it will allow patent to issue. The ruling by the Land Office that diamond-drilling would count as patent expenditure was helpful, and advantage of it will be taken by many shale companies. That expenditures for assessment work may amount to a large sum is evidenced by the accepted estimate that over $500,000 was expended in the development of Colorado shale-lands and in land purchases during the past year, even during business depression.

GRAND VALLEY. In this district the most notable feature has been the acquiring, largely by purchase, by the Union Oil Co. of California of more than 20,000 acres in the upper branches of Parachute creek. Upon the larger part of this tract the work required has been done for patent purposes and the land has gone to patent.

The Columbia Oil Shale & Refining Co., controlled by Tennessee people, has acquired 5000 acres on the east-middle fork of Parachute creek, and is doing the necessary work toward patent. The company has built a 100-hp. hydro-electric plant, to be used largely in experimenting with electrically-heated retorts. The staff is at present engaged in hand-sampling and testing 1200 ft. of shale formation. This is one of the few properties on which such hand-sampling can be done to advantage.

The Reed-Doyle interests, owning a large patented tract immediately adjacent to the town of Grand Valley, have a new equipment, consisting of a surface-tram to transport material from their main shale vein in the mountain to the plant in the valley. Crushers, steam- and gas-engines, and a hoist were also installed. This company planned early last year to use retorts and the Taff process.

All the desirable land in this district has been acquired by companies that are not disposed to sell, so that at present no shale-lands are on the market.

DE BEQUE. In this field the largest holding is controlled by the Ventura Consolidated Oil Co. of California, which has purchased a tract of 10,000 acres on Brush creek. The main work this year was the successful diamond-drilling of the holdings. This will give much-needed information in regard to the number, thickness, and yield of the various oil-shale beds, and other data that are impossible to secure accurately otherwise, owing to the extreme ruggedness of the country and the weathering of the outcrops. It would be well if this company would give information on the increase or decrease of oil-content away from the outcrop.

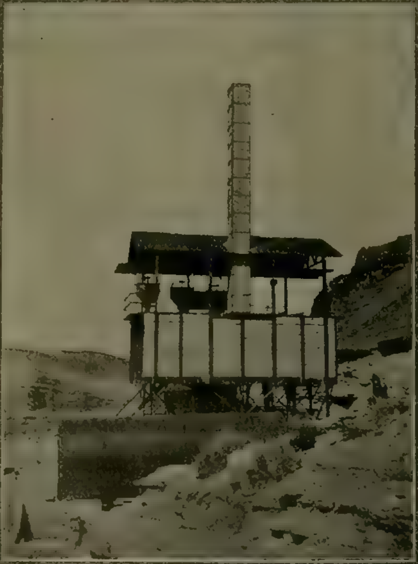
The Index Oil Shale Co. has installed a Brown retort, of 100 tons daily capacity, on the Mt. Blaine holdings. This retort consists of a horizontal cylinder 2½ ft. diameter and 75 ft. long, made up in three sections, each 25 ft. long. The shale, crushed to 1 in., is introduced at one end and moved along by spiral fins to the other end, where the spent shale is discharged under a water-seal. This cylinder itself rotates, the gases being drawn off at three places and taken to the air-condenser. The inner cylinder is enclosed in an outer stationary cylinder. The interesting feature of this retort is that the heating is done wholly with the fixed gases given off from the shale during the retorting. These gases are introduced and burned in the space between the outer stationary and the inner revolving cylinder.

The Monarch Shale Oil Co. erected a plant on Conn creek and use the Ginet process. The apparatus consists of a horizontal shell 3 ft. diameter and 25 ft. long, made in ten sections, each 30 in. long, bolted together. Within the shell is a shaft to which are attached 26 arms carrying agitating-shovels. The shaft rotates, the shovels agitate the shale, moving it through the retort and also scraping the inside of the retort, so as to remove the carbon. This retort has 39 outlets that lead the gases and vapors to the condenser. The furnace is made of fire-brick, the heat being supplied by oil- and gas-heaters. After operations are started, enough gas is produced to supply the heat. An interesting feature of this process is that the shale is pre-heated to drive off moisture before being charged into the retorts. Oil has been shipped from this plant to several metal-mining companies for experimental flotation purposes.

A small unit of the Simplex retort is used on Mt. Logan near De Beque. This consists of a retort in the form of a half cylinder 21 ft. long inclined at an angle of 14°. The retort is encased in fire-brick, the flat side being below. The heat is applied on the bottom of a chamber 6 in. deep. The shale is ground to pass a 12-mesh screen and is carried through the retort in six minutes by a screw-conveyor. This is an experimental retort of a capacity of seven tons daily. On this property a tunnel has been driven 100 ft. on an 8-ft. seam said to yield 50 gal. oil per ton. From here the shale is transported to the retort by a rope tramway.

SHALE FORMATION on PARACHUTE CREEK

CLIFFS of OIL-SHALE in COLORADO


WALLACE PLANT at WATSON, UTAH

FIRST UNIT of the GALLOUPE PLANT

BATTLEMENT MESA. Across the valley of the Colorado river from the main shale-fields, and south of the river, are the Battlement Mesa shales. Battlement Mesa itself is a large mountain of rounded outline rising to 10,000 ft., is heavily wooded, and is crossed by numerous streams. Geologically this mesa consists of the lower members of the Green River (or oil-shale) formation, the upper half having been eroded. The crest of this mountain is composed of basalt, which forced its way up through the shale beds, covering the Mesa with basalt float as far down as the Colorado river. The centre of the eruption coincides closely with the crest of the mountain. Several basic dikes cut through the shale. In the area of volcanic activity much of the shale is broken and burned, and the question is—to what extent has the lava affected the shale? This might be answered by the Pure Oil Co., which diamond-drilled part of this tract last summer.

WATSON (UTAH). This field is so close to the Colorado line that it may be mentioned here. It is of arid character, such water as exists being too alkaline for use. The White river traverses this district, but at most seasons of the year it is a sluggish and muddy stream. The district is given over to sheep-raising and the mining of gilsonite.

The Ute Oil Co. owns large holdings along the White river and is constructing a 400-ton Wallace retort, which will probably be completed this year. This plant is of substantial construction and consists of two sections of nine retorts each. Each retort will hold about 1500 lb. per charge. The operation is non-continuous, the time of run varying from one hour to two and a half hours. Shale is crushed to ½ in. Each retort consists of an outer and an inner vertical cylinder 13 ft. high. The outer cylinder is 30 in. diameter at the bottom and 24 in. at the top; it is encased in fire-brick, the heat being applied to the outside. The inner cylinder is of such a size as to leave a space of 8 in. between the two, this being the thickness of the bed of shale. The inner cylinder is perforated, a slight vacuum withdrawing the gases.

The Western Shale Oil Co. has a Galloupe plant, which was enlarged this year. The retort is vertical and consists of an inner and an outer cylinder with a space of 4 in. between the two for the shale. The retorts are 18 to 21 ft. high, being bolted together in 1-ft. sections. Each section has an outlet for gas and vapor. Fins attached to both outer and inner cylinders serve to agitate the shale. Heat is applied outside the outer cylinder and inside the inner cylinder. The retort is encased in fire-brick. No plant is as yet operating continuously on a commercial basis; but it must be recognized that anything new is of slow development. The industry is getting on a firmer foundation as substantial companies enter the field.

Training the Engineer

Asserting that the education for the engineer is the same as for any other individual, President John Grier Hibben of Princeton University declares in a statement written for the American Society of Mechanical Engineers that true education has for its object both the trained mind and the thoroughly trustworthy character. One who has a highly developed mental equipment without character is a menace to the community, he states. One who has character without mind, however high may be his purpose and ambition, proves ineffectual in the contests and conflicts of life. "The discipline of the mind depends more upon the methods of teaching than the subjects taught," President Hibben continues. "In preparing for the career of an engineer, as for any other profession, it is indispensable for future success and conspicuous leadership that the student should be led to a firm grasp of fundamental principles, rather than the mere accumulation of facts. The fundamental sciences—mathematics, physics, and chemistry—must be mastered by every student of engineering. To acquire a knowledge of these sciences, encyclopedic information is not adequate. Many centuries ago Aristotle remarked that there are two types of mind, the one that acquaints itself with the facts of a subject, and the other that penetrates to the reasons underlying these facts. The latter, he adds, is the philosophic mind. By a philosophic mind, Aristotle meant what we today would characterize as the scientific mind. The true engineer must be the scientific engineer, that is, the one acquainted with the great fundamental principles of the underlying sciences of his profession—one who early acquires the habit of asking why, and searching for the answer with eagerness of spirit as for a hidden treasure. To learn a rule easily applicable to familiar conditions and to apply the same with facility calls for a mind of intelligence, of course, but one acting only on the low level of routine. But to encounter a problem not familiar because disguised by entirely new conditions, to penetrate to the heart of the difficulty, to seize upon the possibility of applying some fundamental principle of mechanics or of mathematical law, and to devise a method of procedure that will attain the desired result—this requires the talent of the truly scientific mind. Throughout the whole of the training of the engineer there must be one supreme objective held in view by the teacher and by the student alike—the development of the resourceful mind. The difficult problems that come to the engineer, however highly specialized his work may be, cannot be solved satisfactorily by a knowledge only of his specialty. A problem in mechanical engineering may require the mechanical engineer to make an excursion into neighboring fields for the solution of the problem. No method in education, moreover, is satisfactory which appeals solely, or in a large measure, to the memory. The point of attack must always be the reasoning powers of the student. Not only that, but there must be in the schedule of his studies and in the method of teaching a constant stimulation also of his powers of imagination. I do not refer to the unlicensed ranging of his fancy in fields foreign to his subject, but I do insist that the mind be quickened in the solution of any problem by the discernment of all the possibilities of solution which may be dictated by the reason. When an unfamiliar situation develops in any engineering enterprise, standing as a stubborn obstacle in the way of progress, it is the mind possessing imaginative skill that immediately brings before its scrutiny the complete array of possibilities of explaining the fundamental reason for the obstacle, and of suggesting a proper and suitable method by which it may be overcome.

"There is another phase in the career of the engineer, in common with all men whose work is to possess some permanent value for his day and generation: He must be able to deal successfully with the human elements in his problelms as well as the material. The engineer who compels the forces of nature and the powers of men to do his bidding, who brings to his task, whether great or small, a creative spirit, who regards obstacles as a challenge gladly welcomed, and who has the courage to attempt that which to men of restricted vision seems impossible, such is the one who not only attains success as an engineer but is capable of contributing richly to the advancement of knowledge."

Book Reviews

Mineral Land Surveying. By J. Underhill. 237 pp., ill. John Wiley & Sons, New York. For sale by 'Mining and Scientific Press'. Price, $3.50.

This is the third edition of a book that describes the methods used in the survey of mineral lands in the western portion of the United States. It has been revised to represent present-day practice; several additions have been made, and the specimen field notes have been re-written. The contents are as follows: I. Direct solar observations. II. Solar attachments. III. Measurements. IV. Location surveys. V. Patent surveys. VI. Patent field notes. VII. Land office and records. VIII. Examination for commission as U. S Mineral Surveyor. Appendix.

A Life of George Westinghouse. By Henry G. Prout. Chas. Scribner's Sons, New York. 374 pp., ill. Price, $2.50.

An exceptional book giving an interesting account of an exceptional career. The activities of George Westinghouse were so many and so varied and he was engaged with so many different problems at the same time that the author found it preferable to divide the technical portion of the book into sundry sections, each treating of the development of one of the arts or projects with which the name of Westinghouse is linked, rather than to present a chronological record of his work. The following list of chapter titles reveals the remarkable diversity of the man as an engineer and inventor: 'The Air Brake'; 'The Friction Draft Gear'; 'A General Stretch of Electric Activities'; 'The Induction Motor and Meter'; 'The Rotary Converter'; 'The Chicago World's Fair'; 'Niagara Falls'; 'Electric Traction'; 'Steam and Gas Engines'; 'The Turbo Generator'; 'Signalling and Interlocking'; 'Natural Gas'; and 'European Enterprises'. George Westinghouse is best known, perhaps, for his work in perfecting the air-brake and for the development of electric-power generation and distribution by means of the alternating current; these two things are easily numbered among the most important factors in industrial progress during the last century. The technical chapters are complemented by several dealing with the private life and the personality of George Westinghouse. Among his friends were numbered scientists, statesmen, and workmen in the plants whose operations he directed. The book is a deserved tribute to an unusually useful man.

Text-book of Inorganic Chemistry. By A. F. Holleman and H. C. Cooper. viii + 528 pp., ill. John Wiley & Sons, New York. For sale by 'Mining and Scientific Press'. Price, $3.50.

This is the sixth edition of a well-known treatise originally written in Dutch. Much of the matter dealing with modern atomistics has been re-written. Due attention has been paid to the discoveries that remained unpublished during the War. The contents are as follows: Introduction. Physical and chemical phenomena. Chemical operations. The elements. Oxygen. Hydrogen. The conservation of matter. Water. Compounds and mixtures. Explanation of the constant composition of compounds. Atomic theory. Stoichiometrical calculations. Chlorine. Ozone. Hydrogen peroxide. Molecular weight from the measurement of the depression of the freezing-point and elevation of the boiling-point. Bromine. Iodine. Dissociation. Fluorine. Electrolytic dissociation. Sulphur. Selenium and tellurium. Thermochemistry. Nitrogen. Phosphorus. Arsenic. Antimony. Bismuth. Carbon. Silicon. Germanium. Tin. Lead. The noble gases: argon, helium, etc. Methods of determining atomic weights. Periodic system of the elements: lithium and sodium, potassium, rubidium, and caesium. Ammonium salts. Salt solutions. Acidimetry and alkalimetry. Copper. Silver. Gold. Beryllium and magnesium. Calcium. Strontium and barium. Spectroscopy. Radioactive elements. Definition of elements. Atomic structure. Unity of matter. Zinc. Cadmium. Mercury. Electrochemistry. Boron. Aluminum. Rare earths. Titanium, zirconium, and thorium. Vanadium, niobium, and tantalum. Chromium group. Manganese. Iron. Cobalt and nickel. Platinum metals. The metallic state and intermetallic compounds. Metal-ammonia compounds.

Recent Publications

Gold, Silver, Copper, Lead, and Zinc in Montana in 1920. Mines Report. By C. N. Gerry. I:14, U. S. Geological Survey, 1921. 25 pp. From Mineral Resources of the United States, 1920—Part I.

Zinc in 1920. By C. E. Siebenthal and A. Stoll. I:15, U. S. Geological Survey, 1921. 17 pp. From Mineral Resources of the United States, 1920—Part I.

Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington in 1920. Mines Report. By C. N. Gerry. I:16, U. S. Geological Survey, 1921. 31 pp. From Mineral Resources of the United States, 1920—Part I.

Gold, Silver, Copper, Lead, and Zinc in Utah in 1920. Mines Report. By V. C. Heikes. I:18, U. S. Geological Survey, 1922. 23 pp. From Mineral Resources of the United States, 1920—Part I.

Gold, Silver, Copper, Lead, and Zinc in Nevada in 1920. Mines Report. By V. C. Heikes. I:19, U. S. Geological Survey, 1922. 29 pp. From Mineral Resources of the United States, 1920—Part I.

Gold, Silver, Copper, Lead, and Zinc in Arizona in 1920. Mines Report. By V. C. Heikes, I:20, U. S. Geological Survey, 1921. 26 pp. From Mineral Resources of the United States, 1920—Part I.

Iron Ore, Pig Iron, and Steel in 1920. By Ernest F. Burchard and Hubert W. Davis. I:21, U. S. Geological Survey, 1922. 45 pp. From Mineral Resources of the United States, 1920—Part I.

West Virginia Survey. Nicholas County. By David B. Reger, and Others. 847 pp., index, ill., maps. I. C. White, State Geologist, 1921.

Tin in 1919. By Adolph Knopf and Bertrand L. Johnson. I:28, U. S. Geological Survey, 1922. 4 pp. From Mineral Resources of the United States, 1919—Part I.

Barytes and Barium Products in 1920. By George W. Stose. II:23, U. S. Geological Survey, 1921. 11 pp. From Mineral Resources of the United States, 1920—Part II.

Talc and Soapstone in 1920. By Edward Sampson. II:24, U. S. Geological Survey, 1922. 13 pp. From Mineral Resources of the United States, 1920—Part II.

Gems and Precious Stones in 1920. By B. H. Stoddard. II:25, U. S. Geological Survey, 1921. 4 pp. From Mineral Resources of the United States, 1920—Part II.

Concrete Stone and Concrete Blocks in 1920. By R. W. Stone. II:26, U. S. Geological Survey, 1922. 5 pp. From Mineral Resources of the United States, 1920—Part II.

Natural-Gas Gasoline in 1919. By E. G. Sievers. II:34, U. S. Geological Survey, 1921. 15 pp. From Mineral Resources of the United States, 1919—Part II.

Lignite in the Western Part of the Fort Berthold Indian Reservation South of Missouri River, North Dakota. By Clyde Max. Bauer and Frank A. Herald. Bull. 726-D, U. S. Geological Survey, 1921. 175 pp., ill., plates, maps.

Geologic Structure and Oil and Gas Prospects of a Part of Jefferson County, Oklahoma. By Heath M. Robinson. Bull. 726-F, U. S. Geological Survey, 1921. 26 pp., ill. From Contributions to Economic Geology, 1921—Part II.

REVIEW OF MINING

UTAH-APEX WINS IN SUPREME COURT

The decision of the lower Federal courts in favor of the Utah-Apex Mining Co. in its litigation with the Utah Consolidated company over orebodies situated in the Bingham district, in Utah, must stand. The Supreme Court, on March 6, refused to consider it. The Utah Consolidated company lost in the lower courts and brought four cases to the Supreme Court for review.

The decision closes one of the hardest-fought apex suits in the history of the mining industry. Conflict of the two companies began on November 2, 1919, before Judge Tillman D. Johnson of the United States District Court. Both sides prepared long and carefully for the legal battle. Eminent mining lawyers and geologists were retained in the case. Thousands of feet of workings were run to demonstrate that certain geological conditions prevailed. Expensive glass and wire models of the two companies' mines, showing the vein systems, stopes, and workings, were constructed and brought into court. Among the well-known authorities who testified in the case were Waldemar Lindgren, Andrew C. Lawson, Albert Burch, George D. Blood, and Orrin P. Peterson. Accounting in the litigation set the value of the ore which had been involved in the contest at approximately $1,200,000.

Utah-Apex Mine at Bingham, Utah

REDUCTION OF FREIGHT-RATES ON MINE PRODUCTS NECESSARY TO RESTORE TRAFFIC, SAYS EXPERT

Recommending a uniform reduction of freight-rates on ores and concentrates throughout Colorado, a revision of rates on coal and coke from producing centres to metal mines and smelters, and a modification of rates on lead bullion and copper matte from Colorado points to the Atlantic seaboard, to a parity with those in force prior to 1918, McKinley W. Kreigh addressed the Interstate Commerce Commission on behalf of Colorado metal miners. He stated that nothing will restore the position of Colorado as a smelting centre, except a return to the rates in force prior to May 1918. After pointing out how Colorado ore tonnage had steadily declined from 573,827 tons in 1916, 540,924 in 1917, 482,834 in 1918, 308,204 in 1919, 298,331 in 1920, to 216,000 in 1921 owing to increased rates, he said that the ore producers had been compelled to absorb the entire amount of the increases, and that many of these producers had been compelled to cease operations, which meant a great financial loss to the carriers. With the closing of the hearings, it became apparent to close observers that the Commission was impressed with the fact that the rate on basic commodities, such as raw mine products, must be reduced if the normal volume of traffic is to be restored.

APPROPRIATIONS FOR MINTS AND ASSAY-OFFICES ARE APPROVED

The Treasury Department appropriation bill providing funds for the mint- and assay-service for the year beginning July 1 next has been approved by the President, being the first of the appropriations for mints and assay-offices: Mints: Philadelphia, $486,600; San Francisco, $273,400; Denver, $184,800; New Orleans, $8700; Carson City, Nevada, $3900. Assay-offices: New York, $323,400; installation of ventilating and dust-collecting apparatus in the deposit melting-room of the refinery, $15,000; Seattle, $21,250; Boise, $4900; Helena, $4900; Salt Lake City, $3600; Deadwood, $4300. Office of Director of Mint, $23,680; freight on bullion and coin, $10,000; contingent expenses, $1000; examination of mints, $6000.

SECRETARY FALL RECOMMENDS CONSTRUCTION OF BOULDER CANYON DAM

In submitting to the Senate his report on the proposed Colorado River irrigation and power project, Secretary of the Interior Fall recommended that through suitable legislation the U. S. government undertake the construction of a reservoir at or near Boulder Canyon on the lower Colorado river, the Federal fund to be reimbursed by leasing the power privileges incident thereto. Under the recommendation, any State interested in this development would have the right at its election to contribute an equitable part of the cost of construction of the reservoir and receive for its contribution a proportionate share of the power at cost, to be determined by the Secretary. The proposal is also made that the Secretary be empowered at the full hearing of all concerned to allot the various applicants their due proportion of the power privileges. The report of the Board of Engineers, which has been studying the subject, in the Secretary's report, states that "from facts and studies of probable cost and revenue, we believe that the Boulder Canyon dam for the combined purposes of flood control, irrigation storage, and power development is physically practicable and financially feasible". It is estimated by experts that with 1,500,000 acres of land in the Lower Basin irrigated, and with storage capacity of 31,400,000 acre-feet, it is possible to develop through the proposed project 700,000 hp. In outlining the demands which would be made upon the power to be developed by the Boulder Canyon project, Secretary Fall places the mining industry of Arizona and Nevada first on the list of enterprises that would make use of the power.

OFFICIAL REPORT ON OIL RESOURCES OF MEXICO IS ISSUED AT MEXICO CITY

The chartographic branch of the Department of Agriculture and Public Works of Mexico has just completed a geographical map of mineral resources. According to this report about one-fifth of the territory of this republic is capable of producing oil. The principal oil-zones are those of the Tampico district, but oil will be found in nearly all of the other States. Especially in Coahuila, Durango, and Chihuahua large oil deposits are said to exist. Lower California will also some day be a producer of petroleum. Maps of each State are later on to be published by the Government indicating the most favorable locations for oil according to geologists. These maps will be on sale or distributed as a means of encouraging the oil industry and assisting the exploration of Mexico's immense area of oil lands.

ARIZONA

Bisbee.—The Calumet & Arizona Mining Co. produced 2,462,000 lb. of refined copper in February because it had full ore-beds at its smelting plant. This is about 60% of normal production. The beds were filled last spring when the smelter was shut-down, the ore coming from regular stoping as well as from exploratory work that has been carried on without interruption.

Ajo.—New Cornelia, a subsidiary of Calumet & Arizona, is on approximately a 40% production basis. This property continued to operate, at a greatly reduced rate, when nearly all other copper producers were idle, as it would have been costly to have closed the leaching-plant. For the treatment of the sulphide ores in this property, comprising about 80% of the total deposits, a concentrating plant will have to be built within the next few years. It is planned to have the concentrating plant ready before the carbonate ore has been entirely mined.

CALIFORNIA

Angels Camp.—New development work is being planned at the Angels Camp Deep mine, recently taken over by A. G. Spaulding of the California Exploration Co. of San Francisco. John C. Benson will continue as manager of the property. The sinking of a two-compartment shaft on the Hale vein, east of the present works, is to be commenced at once. It is proposed to continue sinking to a depth of 1000 ft. The shaft in the Hale vein is expected to penetrate the lode in its extension from the Gold Cliff mine, the north boundary of the latter property being identical with the south boundary line of the Hale claim of the Angels Camp Deep holdings.

Grass Valley.—Encouraging indications are reported by the Pittsburg Syndicate in its project of developing a gravel mine at Iowa Hill, according to Lyman Gilmore, who is associated with the Syndicate in the enterprise. Gilmore says that more than 2000 ft. of tunnels and cross-cuts have been driven.

Quincy.—A new record for production was made by the Engels Copper company during February, it is announced by W. R. Lindsay, superintendent. Unusually high averages were maintained throughout the last three months of 1921. In January and February more than 950 tons of ore was extracted daily, making a total of 30,000 tons per month. About 500 men are employed at present. Some mines have been reporting a shortage of labor, but the Engels company has been paying about 25c. per day more than the prevailing wages in Montana and Utah.

Randsburg.—The 110-ft. steel head-frame at the No. 2 shaft of the California Rand mine has been completed and the belt-conveyor from the shaft-bins to the mill will be in place shortly. The No. 2 shaft is vertical, 700 ft. deep and connected with the No. 1 incline on the 11th or 700-ft. level. The flotation mill is said to be treating over 120 tons daily with satisfactory results.——High-grade ore from the 600-ft. and 700-ft. levels of the Coyote mine is being shipped to the Selby smelter. A body of rich ore has been opened within the past week on the 600-ft. level of the Bisbee shaft, south of the Coyote. The north heading in the Bisbee workings and the south heading in the Coyote are said to be less than 120 ft. apart.——A silver vein has been opened on the 200-ft. level of the Black Hawk mine, adjoining the California Rand and Bisbee on the south. The vein has a trend at right angles to that of the gold veins and was found at a cross-fault. The ore, containing 8 oz. silver, is similar to that of the Rand mine, the vein-filling showing the same schist breccia. The 5-stamp test mill on the Black Hawk property is treating ore from the gold veins, extracting 90% of the gold by amalgamation. The continuation of the Rand vein-system is to be explored in Black Hawk territory, a short distance south of the Bisbee shaft. J. O. Greenan is superintendent.

Whiskeytown.—W. M. Parsons, mining engineer of Los Angeles, has arrived here to direct development work at the West End mine, bonded by C. D. Jones & Co. of Hollywood. The same company some time ago bonded the Mascot mine.

The West End mine has not been worked since 1915. The re-timbering of the 100-ft. shaft will be among the first things to be done.

COLORADO

Breckenridge.—The Farrington Mines Co., recently organized for development of 25 claims on Farncomb hill, near the head of Little French gulch, has opened a contact vein by means of four adits and now plans a 50-ton cyanide mill. The ore opened at 400, 600, and 800 ft. runs from $10 to $50 per ton in gold and silver.

Creede.—The new power-plant of the Midwest Mining company is completed and machine-drills are in use extending the tunnel into Mammoth mountain, to intersect the Mammoth lode, pronounced to be the extension of the rich Amethyst vein.——Operations are shortly to be resumed on the Bachelor, on company account. Lessees on the property have ore broken awaiting the opening of the roads.——Commodore lessees last week forwarded a 50-ton shipment to the Arkansas Valley smelter at Leadville.

Cripple Creek.—February production totaled 42,100 tons, with gross bullion value of $346,850. The tonnage treated at the Independence mill of the Portland company was increased to 23,100 of an average value of $3.50 per ton. The Golden Cycle mill, at Colorado Springs, treated the remaining 19,000 tons of an average value of $14 per ton.——Directors of the Cresson Consolidated have declared the regular quarterly dividend of 5c. per share and 5c. extra, payable on April 10 to stock of record as of March 31. The Cresson paid a 10c. dividend in January, the first to be paid since June 1920. The property is reported in fine condition with large reserves added by recent development.

Georgetown.—Copper and iron pyrites assaying as high as $148, chiefly gold, has been opened on the Capital group by the Colorado Mining & Leasing Co.——A new shaft is being sunk by the Gilpin Leasing Co. on its block, and a cross-cut will be carried at 100 ft. to the rich vein opened at the surface.——The Houston lease shipped a car of $100 ore last week.

Idaho Springs.—Silver-lead ore has been opened in an abandoned tunnel in the Freeland district by Charles Olson, who is now driving a new tunnel to cut the vein at greater depth.

Leadville.—Contractors have taken over the Canterbury Hill tunnel project and are making good progress. The contract rate is $9 per foot.

Silver Plume.—The East Butte Copper Co. is rushing construction work on the 500-ton mill now being erected at its newly acquired properties, in order to derive as much benefit as possible from the high price of silver established under the Pittman Act. The mill should be in operation within a month. Careful estimates show at least 1,000,000 tons of rock in the mine that was thrown into stope pillars years ago, when oil-flotation was unheard of, and it was not profitable to treat ore averaging 12 oz. silver per ton. At that time the recovery was but 40 to 50%. Under present-day methods of treatment East Butte expects to obtain a yield of from 10 to 12 oz. silver per ton from this ore. The dumps contain millions of tons that should show profits of from $1.50 to $2.50 per ton. In addition there are possibilities in new ground that may be opened.

Telluride.—Concentrate shipments for February totaled 113 cars, as compared with 143 cars in January and 113 cars in February 1921. The Smuggler-Union shipped 63 cars and the Tomboy Gold Mines, Ltd., 50 cars.

IDAHO

Coeur d'Alene.—A contract to sink 200 ft. to a new low level in the Morning mine has been let by the Federal Mining & Smelting Co. This will give a depth of 2250 ft. in the mine at an elevation of 1450 ft. below the main working-tunnel.——At the 1500-ft. level in the Amazon-Dixie shaft a sump is being sunk and a station cut preparatory to driving a cross-cut to the vein, an estimated distance of 500 ft. The shaft has been sunk from the 1100 to the 1500-ft. level; in the lower levels the formation has changed from the St. Regis to the Revett. The ore is silver-lead-copper.

The Independence Lead Mines Co., operating the Independence and Gettysburg groups at Mullan, doubled its working force recently and is now pushing development as fast as possible in the No. 3 tunnel, according to H. W. Ingalls, superintendent. Recently the No. 1 tunnel was opened. In it about 10 ft. of ore that will run between 20 and 25% lead was disclosed within about 50 ft. of the grass roots. The No. 2 tunnel lacks about 50 ft. of being under this shoot. The big ore-shoot recently opened in the No. 3 tunnel is new; no surface work has been done on it heretofore.

MICHIGAN

Houghton.—More timbermen have been put to work in the conglomerate department of Calumet & Hecla, which will resume mining operations about April 1, and several hundred are now employed in getting these shafts in readiness. It is now probable that eight shafts will be ready if needed. It is unlikely that any work will be done at the reclamation plant at Lake Linden until the ice is out of Torch lake. The dredge is still lodged in ice. The tables must be overhauled and eletrical equipment replaced before this plant can start. The date of its resumption no doubt will be largely determined by the improvement that is made in the copper market.

The work of repairing and overhauling the Ahmeek stamp-mill has been started. Only a small force is employed, as the plant generally is in good condition, requiring only minor repairs. Ahmeek will be one of the first, if not the first, of the Calumet & Hecla subsidiaries to get back to normal.

At Seneca all drifts north from the Seneca shaft toward Gratiot ground are in good ore averaging, with reasonable selection, 35 lb. per ton. The third-level drift, the longest of the openings, has been continuously in good milling ground, with no evidence of faulting. At the seventh level, south, the mineralization is heavy. Eventually the third level will connect the Gratiot No. 2 shaft, which is being prepared for resumption of sinking. The collar in this shaft has been completed and the work of re-building the shaft is now under way below the sixth level. The shaft is bottomed at the 13th, and sinking probably will be resumed in four or five months. Construction of the new power- and engine-houses and railway tracks will be pushed as soon as the snow leaves the ground.

MONTANA

Great Falls.—The American Zinc, Lead & Smelting Co. has purchased a controlling interest in the Silver Dike Mining Co., whose properties are near here. Including money expended for development work, the company paid approximately $125,000 for its Silver Dike holdings. There is indicated an orebody containing approximately 500,000 tons of silver-lead-copper ore, which will average from assays to date about $10 per ton gross on present metal prices. The mine is situated about 2½ miles from the railroad; with the transmission line of the Montana Power Co. available as a source of power, and with plenty of water and timber available, it is expected a low cost can be obtained. Concentrates can be shipped to the Anaconda smelter at Great Falls, or to the Helena smelter of the American Smelting & Refining Co. The Silver Dike holdings comprise an orebody about 700 ft. above the foot of a small mountain. It is a zone of brecciated porphyry opened by a tunnel. If further developments prove up the indicated ore, a mill of about 350 tons daily capacity will be built.

NEVADA

Goldfield.—The Silver Coin group of silver claims, situated 23 miles south-east of Goldfield, has been acquired by the Grandma Consolidated Mines Co. Development work will commence at once.

Hornsilver.—A raise 35 ft. above the sixth level in the south-east drift of the Orleans mine has opened a body of ore that averages $20.80 per ton. Work is being done on the 700-ft. level, where milling-ore has been developed not only in the drift, but in a winze sunk to a depth of 80 ft. ——Work on the Nevada Eagle mine is progressing on the 375-ft. level and in a raise of 50 ft. there has been found some ruby silver. The ore in the last 60 ft. of the lower drift averages $22.12 per ton.

Lovelock.—The mill of the Arizona Mines Co. at Unionville has been started after several months of tests. The property was formerly a noted producer of silver.——A new vein of milling ore has been opened on the 900-ft. level of the Rochester mine, considerably east of the main ore-bearing area. The vein is over four feet wide and its discovery opens to mining a new and promising portion of the property.

Minden.—After a delay of more than two months the cross-cut from the 200-ft. shaft on the Veta Grande mine has been cleaned out and drifting will be resumed. When the water drove the miners out of the cross-cut it was in approximately 200 ft. and had just passed through nine feet of a formation that indicated the approach to ore.

Tonopah.—By an agreement entered into between the West End and the MacNamara companies the former will furnish the latter with ore adequate to keep its mill operating at capacity for 24 hours per day. The mill has been running light on custom ores, and the West End has not been able to treat more ore at its own mill, having reached its capacity of 1650 tons per week. By the new arrangement the MacNamara will continue to receive and treat custom ores and at the same time take care of 1500 to 2000 tons per month from the West End, which has been producing at a rate in excess of the capacity of its own mill.

Dividend No. 36, that provides for the distribution of $69,635.72, or 5c. per share, has been declared by the Tonopah Extension Mining Co. It is payable on April 1 to stockholders of record at the close of business on March 11. With the payment of this dividend a total distribution of $2,948,000 to stockholders will have resulted, or $52,000 less than $3,000,000.

Virginia City.—Development work of the Middle Comstock Mines Co. has set some new records. Two drifts, north and south in the lode, and one cross-cut in Hale & Norcross ground have been making 45 ft. advance daily, or an average of 15 ft. in three shifts for each heading. It is said that this work has exposed a large tonnage of ore averaging above $10 per ton. After a considerable delay, caused by deep snow, the electric locomotive ordered some time since has been delivered at the Hale & Norcross tunnel and the mining plant is complete. It is reported that Dr. M. R. Ward, president, and Charles M. Schwab, the leading figure in financing this enterprise, will arrive at Virginia City early in April to inspect the property. The options on the Middle Mines group of old bonanza mines run to June 1, but a first payment was made more than a month ago.—— The United Comstock Mines Co., now building a 2500-ton cyanide mill in American Flat, will add a large number of men to its construction forces within another week. Work on the mill has been impeded by storms of great violence and by deep snow, blocking all roads to the plant. The approaching headings of the 10,000-ft. haulage tunnel, between the Belcher and Knickerbocker shafts, will connect within the next week. Cross-cuts are being driven through the lode from the tunnel, which is in the foot-wall country, and a number of ore-passes are being prepared to convey ore from the intermediate tunnel and other repaired or recovered workings.——At the north end of the lode the Mexican mill is treating 130 tons of ore daily from the Consolidated Virginia and Ophir mines, the latter having in sight a substantial tonnage of good mill-grade.——The Sierra Nevada is driving a cross-cut from the 1000-ft. point in its Cedar Hill tunnel. A cross-cut on the Sutro tunnel level in the Union has been driven over 900 ft. to prospect the lode in unexplored territory.——Near Gold Hill the Pittsburg Comstock lower tunnel is advancing on the Bright Star vein and nearing a point under the old surface stopes that yielded bonanza ore, while a drift and cross-cut in the north vein are showing stringers of sulphide of low value.——The Comstock Silver has opened good ore in a winze from its Umatilla tunnel and in a west drift on the 265-ft. level, driven from the Scheels incline to connect with the company's main Overland shaft.

UTAH

Alta.—Twenty inches of high-grade ore assaying 45.9% lead and 84.8 oz. silver has been exposed in the Emma mine, according to M. M. Johnson, consulting engineer. This showing, which was opened in a raise from the Bay City tunnel on the Montezuma fault, lies in a favorable bed with three feet of mill-ore on the foot-wall. Inasmuch as this deposit is believed to be an extension of the old Gunderson stope, which produced millions, the company is much encouraged by the discovery.

Three feet of high-grade ore has been opened in a cave in the South Hecla property, according to George H. Watson, president. This ore was found in the Rustler drift at a depth of about 1200 ft. below the surface and 2000 ft. from the portal of the Quincy tunnel. Samples of the ore are said to assay 132 oz. silver, $2.50 gold, 5% copper, and 9% lead. The cave is about 40 ft. long, 5 ft. wide, and 70 ft. high.

Beryl.—Development work in the Pinto Iron Mountain district being done by the Copper Zone Mining Co. is encouraging, according to F. A. V. Kesselhut, consulting engineer. A full face of high-grade gold-silver ore has been opened at a depth of 1000 ft. below the surface on the foot-wall side of a strong fissure traversing soft dolomitic limestone. The company is now driving its drift along the fissure to its intersection with the main porphyry dike on the contact.

Eureka.—Tintic mining men are following with close interest the result of exploration work being done on the 1100-ft. level of the North Standard mine. Interest has resulted not so much because of the size and value of the orebody as from the fact that the recent discovery indicates that the Tintic Standard ore-channel extends several miles northward from that mine. Approximately 2000 ft. south of the North Standard shaft, the Chief Consolidated company is running drifts from the 1440-ft. level of the Water Lily shaft to explore the northern extension of the Tintic Standard channel. If the strike in the North Standard develops into a large orebody, it will mean much to the East Tintic district.

A station has been cut at the 1400-ft. level of the Chief Consolidated No. 2 shaft and drifting has been started. This is the third level to be prospected in this shaft. Two other levels are being run; one on the 1600 and the other on the 1800-ft. level. On the 1400-ft. level, drifting will be carried on to the east of the shaft in order to reach the porphyry-lime contact in the shortest possible distance.

Production of ore by the Tintic mines for the week ending March 4 totaled 122 carloads as compared with 148 carloads for the week preceding. Output follows: Tintic Standard, 43 cars; Chief Consolidated, 36; Eagle & Blue Bell, 9; Grand Central, 6; Iron Blossom, 5; Colorado, 5; Victoria, 5; Centennial-Eureka, 2; Swansea, 2; Alaska, 2;

Empire Mines, 1; Bullion-Beck, 1; Dragon, 1; Gemini, 1; Eureka Mines, 1; Sunbeam, 1; Tintic Drain Tunnel, 1.

Park City.—Park City mines increased their output of ore from 2814 tons for the week preceding to 3032 tons for the seven days ended March 4. Most of the increase, however, was due to the increased tonnage produced by the Judge allied companies. Production follows: Judge allied companies, 1597 tons; Silver King Coalition, 885; and Ontario, 550; total, 3032 tons.

Salt Lake City.—Arrangements for a number of plans for the stimulation of the mining industry in Utah are being made by the mining committee of the Commercial Club. An invitation will be extended by the club to the American Institute of Mining Engineers to hold its 1922 convention in Salt Lake City. Plans are being considered for a banquet, to be given by the mining committee, to which all Utah mining operators will be invited. The purpose of this banquet will be not only to celebrate the achievements of the mining committee, but to awaken a spirit of co-operation among Utah operators. Celebration of the sixtieth anniversary of the location of the first mining claim in Utah in September is also planned.

WASHINGTON

Colville.—The tunnel at the Chloride Queen mine has entered rich ore, according to Dave E. Zent, manager. Some of this ore assays 46% lead.

Keller.—A vein of silver-lead ore at the Iron Creek mine, 12 miles north of here, is believed to be the richest find ever made in the San Poil mining district. Plans have been made to double the capacity of the small cyanide plant at the mine.

BRITISH COLUMBIA

Hudson's Hope.—The Peace River Gold Dredging Co., which recently absorbed the Ingenika Gold Mining Co., has made arrangements to start dredging operations on the Peace river, above Hudson's Hope Canyon, during the coming summer; eight carloads of machinery, including the dredge, have been delivered at Spirit, and are being hauled from there to the company's property. The company has leased dredging ground along 14 miles of the river. This has been thoroughly explored during the last two years, and, it is expected, will give a profitable return.

New Hazelton.—The ore-bins at the Silver Standard mill have been filled to capacity, and a quantity of clean ore has been sacked ready for shipping. The mill, which has been closed for some 18 months, will be re-started as soon as the necessary repairs can be made to the flumes that carry the water that provides the motive power. At the present time these are frozen solid, and little can be done until the weather breaks. In the meantime development work will be continued in the mine.

Quesnel.—All indications point to a marked revival of mining and prospecting in this district during the coming summer. Prospectors already are assembling in considerable numbers at Cedar creek, which is the centre of the excitement, although practically no prospecting can be done before the beginning of April. The New York syndicate that bonded the Pratt and Lyons claim, on which the original discovery was made, has shipped in a quantity of machinery. The first payment on the claim falls due on April 15. The consideration is unofficially stated to be $200,000. The property is situated on Cedar creek, a tributary to Quesnel lake.

Renata.—O. W. Wheeler and associates, who own the Mountain Chief mine, have made what appears to be an important find on the 50-ft. level; it consists of a strong body of copper-carbonate ore, running between 20 and 30% copper and carrying in addition a small quantity of silver and gold.

Stewart.—R. W. Wood, of the Premier Gold Mining Co., was here recently, and has taken options on a number of claims in the vicinity of the Premier. Recently the Premier company bought 550, out of a total of 1500 shares in the B. C. Silver Mines, Ltd., which adjoins the Premier on both north and south. Wood stated that the company was acquiring such claims as it was thought might be useful in the further development of the mine. The company now has 430 men on its payroll.

Trail.—The ore receipts at the smelter for the last week in February amounted to 7086 tons, the only independent shippers being the Bell, at Beaverdell, with 47 tons, and the Standard, at Silverton, with 82 tons. Owing to the probability of a long strike in the Crow's Nest Coal Fields, the company is stocking a large supply of coke. It is stated that in the event of a prolonged strike the Consolidated company will erect by-product coke-ovens here, and use coal from the Princeton-Nicola or the mines situated on Vancouver Island.

Railway Near Alice Arm in British Columbia

Vancouver.—During the last two weeks divers have been salvaging the copper that fell into Burrard inlet when part of the C. P. R. pier collapsed; the bulk of the metal has been recovered.

Victoria.—R. S. Maybee, of this city, has purchased a controlling interest in the Indian mine, in the Salmon River district. A lode of milling ore, ranging from 6 to 14 ft. in thickness, has been traced for 1000 ft. by open-cuts, while in some of the cuts there is two or three feet of galena ore, carrying on an average ¾ oz. silver per unit of lead, that can be shipped.

MEXICO

Chihuahua.—A new group of mines has been taken up by Anastasio Parra. It is composed of 12 contiguous claims situated in the Ocampo mining district near the old Promontorio mine, east of the San Francisco. The ores from this district carry gold, silver, and lead.——Agapito Millan is preparing to work the Trickner mine in the Ocampo region. This property is situated on the El Trigo ranch and is traversed by a strong vein of gold and silver.——In the Guerrero district, Benedict Rojo is opening some new properties in the vicinity of the Divina Providencia and San Juan de Dios mines. He is preparing to work both the Virgin Pura and the Aurora properties.

John Jayme has located the Esperanza mine, comprising five claims, carrying gold, silver, and lead, situated in the Cordero camp near Parral. The survey will include a portion of the old Boquilla mine, which was allowed to go by default, near the Santa Eduwigs, San Antonio Chico, Luz, and Tokio properties.——Salome Botello, a prominent attorney of Monterrey, is filing on several groups of mines in the Sierra Colorada, of the Camargo district.

Zacatecas.—Dr. Fred W. Taube, of this city, has taken up the Ampliacion del Centenario, a group of ten mining claims in the Gil mountains near the City of Zacatecas. It is situated a short distance south-east of the original Centenario mine. Development work is to be commenced on this property within a short time. The official survey and plans are being made by Francisco Lopez.——Prospero Ternes, of the Minillas camp, has re-filed on a portion of the old San Pedro, El Porvenir, and Santo Domingo mines in the municipality of Ojocaliente. These mines were recently declared forfeited. Some of the old workings are to be cleaned out, with the expectation of making substantial shipments soon.

Bernabe H. Cruz, of Monterrey, has filed several new locations with the mining agent at Concepcion del Oro. Two of the principal groups taken up, and which will be extensively developed, are the San Pedro y Pablo and the Minerva. Both carry silver, lead, and iron.——Manuel M. Trevino has applied for titles to the vacant ground around the Cuatro Amigos, San Jose, Aurora, and La Sierra mines in the Concepcion del Oro. The surveys are being made by E. N. Abbott.

ONTARIO

Cobalt.—The La Rose Consolidated has declared a dividend of 10%, payable on April 20. The annual report shows profits of $126,088, and as the dividend calls for $150,000 the balance will come from surplus, which on December 31 amounted to $555,910.——At the Silver Cliff mine good ore is being taken out, yielding between 40 and 50 oz. per ton, being about double the silver content of ore previously treated.

Kirkland Lake.—The Hyland-Kirkland has changed hands, having been purchased by British and Canadian interests. Arrangements have been made for exploration by diamond-drilling, with M. T. Barney in charge. The property comprises 561 acres south of the Hunton Kirkland. A merger of the Ontario Kirkland and the Montreal Kirkland is being arranged involving the organization of a new company with $5,000,000 capital, of which $1,500,000 will be allotted to the Ontario Kirkland and $1,725,000 to the Montreal Kirkland. Montreal capitalists are interested.

Toronto.—The Professional Engineers Bill now before the Ontario Legislature, providing that engineers must be professionally organized and that all engineering work by others than registered engineers be prohibited, was strongly opposed by the mining interests. An amendment has been adopted which exempts mining work from the operation of the bill, but leaves mining engineers free to register if they wish to become entitled to describe themselves as "registered professional engineers". This amendment is generally acceptable to the mining industry.

PERSONAL

Charles A. Green, of Imlay, Nevada, is in San Francisco.

J. B. Tyrrell and **Mrs. Tyrrell** left Toronto for England on March 8.

Andrew W. Newberry, of New York, was here this week, after a visit to Tonopah, Nevada.

Carl N. Anderson passed through San Francisco on his return to Portland, Oregon, from Yuma, Arizona.

C. W. Purington has been at Vladivostok during January and February, and has now returned to Yokohama.

W. J. Quigley, of El Paso, has returned from Chihuahua, Mexico, and is here on his way to British Columbia.

Walter B. Gates is now in charge of the smelter of the American Smelting & Refining Co., at Morris, Chihuahua.

S. F. Shaw is now the manager of the properties of the Cia. Minera de Peñoles in the Sierra Mojada district, Mexico.

Jesse J. MacDonald is doing examination work for the Philadelphia Mining Co. in the Bradshaw mountains, Arizona.

A. B. Parsons is visiting Los Angeles. On March 29 he starts for New York, to join the editorial staff of the 'Journal-Press'.

D. H. Bradley, Jr., of San Francisco, is returning to Nogales, Arizona, where he has been on professional work for the last month.

E. P. Mathewson, on his arrival from Burma, gave an address before the Mining Association of the University of California on March 14.

Willam H. Webster, assistant manager for the Copper Queen Branch of the Phelps Dodge Corporation, has resigned, and will move to New York shortly.

Frank L. Stack expects to return to the United States in May, having successfully developed a new type of anode for the electrolytic tank-house of the Chile Exploration Co.

C. Colcock Jones has returned to Los Angeles after an absence of several months in the various oil regions of Mexico in the interest of the Union Oil Co. of California.

James R. Hobbins, who for the past six years has been district manager for the Montana Power Co. at Great Falls, is assistant to the president of the Anaconda Copper Mining Co.

Eugene R. Day, of Wallace, Idaho, mining operator of the Coeur d'Alene district of northern Idaho, died at Spokane, Washington, on February 11, after several months' illness. With his two brothers, Harry L. Day, of Oakland, California, and Jerome J. Day, of Moscow, Idaho, Eugene R. Day owned a controlling interest in the Hercules silver-lead mine at Burke. In addition, the three brothers controlled the Tamarack & Custer mine. He was born at Truckee, California, in August 1874, and removed to the Coeur d'Alene district with his parents in 1886. Besides his brothers, he is survived by two sisters and by his widow, who live at Portland, Oregon.

In the 'Mining and Scientific Press' of February 25, 1922, the pages are misnumbered so that 269 and 270 are apparently lacking. No matter is omitted, however, the error being one of numbering only. Pages 281 and 282 are the last pages in the issue of February 25 and are repeated as the first two pages in the issue of March 4. This statement is made to explain any future question as to the apparent faultiness of Vol. 124 when bound.

THE METAL MARKET

METAL PRICES

San Francisco, March 14

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	13—13.75
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$90
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.50—7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

March 13.—Copper is more active and stronger. Lead is steady and firm. Zinc is quiet and higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Mch.	7	64.25	33.12½	Jan.	30	65.46	35.06
"	8	63.50	28.87½	Feb.	6	66.35	35.00
"	9	64.25	33.25	"	13	65.75	34.22
"	10	65.12½	33.75	"	20	65.44	34.23
"	11	64.25	33.25	"	27	64.00	32.92
"	12 Sunday			Mch.	6	63.44	32.52
"	13	63.87½	33.37½	"	13	64.21	33.26

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	132.77	65.95	65.45	July	92.04	59.99	....
Feb.	131.27	59.55	65.28	Aug.	96.23	61.59	....
Mch.	125.70	56.08	....	Sept.	93.66	66.22	....
Apr.	119.56	59.33	....	Oct.	83.48	71.00	....
May	102.69	59.90	....	Nov.	77.73	68.24	....
June	90.84	58.51	....	Dec.	64.78	65.76	....

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Mch.	7	12.75	Jan.	30	13.48
"	8	12.75	Feb.	6	13.29
"	9	12.75	"	13	13.17
"	10	12.75	"	20	12.88
"	11	12.75	"	27	12.60
"	12 Sunday		Mch.	6	12.58
"	13	12.87½	"	13	12.77

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	19.25	12.94	13.54	July	19.00	12.46	....
Feb.	19.05	12.84	12.95	Aug.	19.00	11.71	....
Mch.	18.49	12.20	....	Sept.	18.75	12.03	....
Apr.	19.23	12.50	....	Oct.	16.53	12.66	....
May	19.05	12.74	....	Nov.	14.63	13.07	....
June	19.00	12.83	....	Dec.	13.18	13.54	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Mch.	7	4.70	Jan.	30	4.70
"	8	4.70	Feb.	6	4.70
"	9	4.70	"	13	4.70
"	10	4.70	"	20	4.70
"	11	4.70	"	27	4.70
"	12 Sunday		"	6	4.70
"	13	4.70	"	13	4.70

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	8.65	4.96	4.70	July	8.63	4.75	....
Feb.	8.88	4.54	4.70	Aug.	9.03	4.40	....
Mch.	9.22	4.06	....	Sept.	8.08	4.61	....
Apr.	8.78	4.32	....	Oct.	7.28	4.70	....
May	8.55	5.01	....	Nov.	6.37	4.70	....
June	8.43	4.57	....	Dec.	4.76	4.70	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	62.74	35.94	32.04	July	49.29	27.69	....
Feb.	59.87	32.16	30.74	Aug.	47.60	26.35	....
Mch.	61.92	28.87	....	Sept.	44.43	26.70	....
Apr.	62.17	30.36	....	Oct.	40.47	27.70	....
May	54.99	32.50	....	Nov.	36.97	28.93	....
June	48.33	29.39	....	Dec.	34.12	32.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Mch.	7	4.97½	Jan.	30	4.93
"	8	5.00	Feb.	6	4.85
"	9	5.00	"	13	4.84
"	10	5.00	"	20	4.85
"	11	5.00	"	27	4.85
"	12 Sunday		Mch.	6	4.93
"	13	5.05	"	13	5.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	9.56	5.86	5.05	July	8.18	4.41	....
Feb.	9.15	5.34	4.85	Aug.	8.31	4.69	....
Mch.	8.93	5.19	....	Sept.	7.84	4.74	....
Apr.	8.76	5.37	....	Oct.	7.50	5.09	....
May	8.07	5.37	....	Nov.	6.78	5.18	....
June	7.92	4.96	....	Dec.	6.03	5.24	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Feb.	14	50.00	Feb.	28	50.00
"	21	50.00	Mch.	7	50.00
			"	14	50.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	89.00	50.00	50.00	July	88.00	47.75	....
Feb.	81.00	48.75	50.00	Aug.	85.00	47.50	....
Mch.	87.00	45.88	....	Sept.	75.00	47.50	....
Apr.	100.00	46.00	....	Oct.	71.00	46.25	....
May	87.00	50.00	....	Nov.	56.00	40.40	....
June	85.00	49.50	....	Dec.	52.50	49.50	....

OUTLOOK FOR COPPER

In estimating the future of the copper industry in the United States, answers to several questions should be sought. Two of these are, according to a recent report by the chairman of the Twelfth Federal Reserve District: (a) What is the present productive capacity of the mines and refineries of this country, and of the world, in relation to the present consumption of the world? (b) What may be the consumption of the world during the coming years?

The record yearly output of mines in the United States was that of 1916, 1,900,000,000 lb., and of the world that of 1918, 3,260,000,000 lb., figures which may be taken as the present productive capacity of mines. This country's present annual electrolytic refining capacity is over 2,500,000 lb. The record yearly consumption of the world was that of 1918 when it slightly exceeded the world's production during the same period, but, due to the abnormal demands of the War, this figure is of little value today. No later statistics of world consumption are available, but it seems certain that in 1920 it did not equal world consumption in 1913 (2,300,000,000 lb.). (Production in the two years was about the same, but stocks increased by a greater amount during 1920.) And in 1921 world consumption did not equal that of 1920 (the world trend is clearly shown by statistics for the United States). Annual world consumption today is not so great as in 1913, when it was 2,300,000,000 lb. Thus it may be concluded that before production again equals the present productive capacity of the world, not only will the pre-war rate of consumption have to be regained, but it will have to be considerably increased. The present capacity of electrolytic refineries in the United States alone is greater than pre-war consumption of the world, and the output capacity of domestic mines not far below it.

From 1894 to 1914 the consumption of copper by the world increased at an annual rate of 5.7%, according to figures prepared by the Federal Reserve Bank of New York.

World consumption in the years 1912 and 1913 was double that in the years 1900 and 1901. It would be futile to conjecture whether, if it had not been for the War, this rate of annual increase would have continued with the result that world consumption in 1921 would have been 3,500,000,000 lb. Because of the intervention of the War, checking the expansion of many lines of industry, and lessening the purchasing (or consuming) power of the world's population, the chief value of this figure of the annual rate of increase is in answering this question: After the pre-war rate of consumption is restored, and when industry is again expanding its plants and increasing its equipment, what rate of increase in the consumption of copper may be expected to obtain? It would be dangerous to assume that the pre-war rate would continue indefinitely, notwithstanding frequently expressed expectations of great expansion in the electrical industry, the principal consumer of copper. The electrical industry was a rapidly growing industry prior to the War, but experience has shown that the expansion of other new industries has not been unlimited, that a slowing down in the rate of growth has sooner or later occurred.

MONEY AND EXCHANGE

Foreign quotations on March 14 are as follows:

Sterling, dollars:	Cable	4.29¼
	Demand	4.28¾
Franc, cents:	Cable	8.87
	Demand	8.85
Lira, cents:	Demand	4.95
Mark, cent:		0.37½

Eastern Metal Market

New Yark, March 8.

A better feeling pervades nearly all the markets and prices tend higher.

Buying of copper has improved and quotations are advancing.

The tin market has been much quieter but prices have been easy.

Demand and prices for lead continue steady.

Prices in the zinc market have advanced and buying is a little better.

Antimony has declined.

IRON AND STEEL

The first week of March has shown no general increase in operations, says 'The Iron Age'. The Carnegie Steel Co. is to blow-in another blast-furnace next week, the Republic and the Cambria companies one each at their Bessemer plants. Chicago remains a notably active centre. No concern is shown over the impending coal strike. Definite efforts are now being made to stiffen steel prices. With the market still strongly in buyers' hands, and not many mills having more than a month's business ahead, the leading Pittsburgh independent, which in recent weeks made a drive for current business, announced late on Monday a return to a basis of 1.50c.

February pig-iron production was 1,629,991 tons, or 58,214 tons per day. January's total for the 31 days was 1,644,951 tons, or 53,063 tons daily. Of the total daily increase of output of February over January, namely 5151 tons, 4697 tons or over 90% represented the gain of steel-making furnaces. On March 1 there were 138 furnaces in blast, operating at a rate of 59,080 tons per day, against 126 furnaces active on February 1.

The production of steel ingots for February, on a basis of the compilations of the American Iron & Steel Institute, indicates a production of 86,220 tons per day, against 75,700 tons per day in January. The February rate was 26,800,000 tons per year, which is 35% above the actual production of 1921, and the February rate of pig-iron, making 22,250,000 tons, is likewise 35% above the output of last year.

COPPER

The general tone of the market has improved. Most, if not all, of the cheaper lots in speculators' and small producers' hands have disappeared. Consumers are approaching a state of mind, bordering on conviction, that the low point of this movement has been passed and, if the present upward tendency is sustained, they will probably enter the market. As it is, buying has been heavier the last week than for some time, and purchases in February were larger than in January. Electrolytic copper, which was obtainable as low as 12.50c., refinery, a week ago, is now at a minimum of 12.75c., refinery or New York, and 13c. delivered. Inquiry is good, both for domestic and foreign consumption and sales for export have been particularly good lately.

TIN

The past week has been dull and uninteresting. There has been a marked absence of the 'pep' which has been spasmodically a feature in recent weeks. Spot Straits was quoted at 29c., New York, yesterday and prices for the past week have ranged between 29 and 30c. The London market yesterday was about £3 per ton lower than a week ago at £142 for spot standard, £144 10s. for spot Straits with the market weak. Deliveries into consumption in February were 3215 tons, with 506 tons in stock and 900 landing on February 28. Imports to March 1 this year were 7200 tons, as contrasted with 3830 tons to March 1, 1921. Arrivals thus far this month have been 2605 tons and there is reported afloat 6536 tons.

LEAD

The market continues its steady even course without interest or feature. Demand keeps up in a steady stream, practically equal to production. The only change in values is a lowering of the leading interest's St. Louis price from 4.70c. to 4.50c. in order to bring it nearer to the independents' price, which is 4.40c., St. Louis. The New York price of both markets continues unchanged at 4.70c. Independents sell at 4.75c. at other Eastern points.

ZINC

Prices have improved but demand has not increased significantly. Prime Western for early or 30-day delivery is now quoted at 4.62½c., St. Louis, or 4.97½c., New York, against 4.55c., St. Louis, a week ago. While there has been a little better buying for early delivery, the greater strength of the market is due more to the disinclination of producers to make free offerings, as well as to the fact that those Western sellers who followed the market down have turned buyers instead. Future-delivery prices are difficult to secure.

ANTIMONY

The market is lower, due to the pressure to sell a few lots, and wholesale lots for early delivery are quoted at 4.20c., New York, duty paid.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the leading interest in wholesale lots for early delivery at 19 to 19.10c., while the same grade from importers is quoted at 17 to 18c., duty paid.

ORES

Tungsten: There is little change. Some inquiry is reported but prices are nominally unchanged at $2 per unit and higher, depending on the grade, etc. Some sales of Chinese off-grade ores for export are reported at $1.85 per unit, f.a.s., New York.

Molybdenum: The market is dull and without change with quotations at 40 to 50c. per pound of MoS_2 in regular 85% concentrates.

Manganese: Consumers are uninterested and quotations are nominal at 25 to 26c. per unit, c.i.f. seaboard. Imports in January were 9500 tons, against 49,699 tons in January a year ago.

Chrome: Unconfirmed reports state that considerable Indian and Rhodesian ore has been contracted for at $17.50 per ton, c.i.f., New York.

FERRO-ALLOYS

Ferro-manganese: The market is quiet and quotations are unchanged at a basis of $62.50, seaboard, for both British and American alloys. There are inquiries for 1000 and 500 tons. February production was 3610 tons.

Spiegeleisen: Scarcity of all grades continue the feature. In the absence of any stocks of the 20% grade, quotations are not reported, but for the 16 to 19% grade, $30 furnace, is the ruling price. There are moderate sales and inquiries, though some large contracts have been negotiated in recent weeks and one regular producer will blow-in a furnace about March 15. February production was 4930 tons, the largest since early last year.

Ferro-tungsten: The market is inactive and quotations are nominal at 45 to 50c. per pound of contained tungsten in the domestic alloy.

Ferro-chromium: Prices are nominally unchanged at 12 to 14c. per pound of contained chromium, delivered.

Mining and Scientific Press

Entered at the San Francisco postoffice as second class matter

SAN FRANCISCO, MARCH 25, 1922

Volume 124 No. 12
15 Cents per Copy: $4 per Year

AN INDEPENDENT WEEKLY PAPER OWNED, EDITED, AND MANAGED BY ENGINEERS

Last issue - Consolidated with
Engineering & Mining Journal, Apr. 1, '22

Another Victory for the Hardinge Mill

Once again the Hardinge Mill is endorsed by a major mining company — this time the Consolidated Mining & Smelting Company of Canada, Limited.

This company has made a contract under our license to construct Hardinge Mills in its own shops for the many installations under its control.

Could there be a stronger testimony to the achievement of any grinding device than this?

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New And Original Roll-Capacity Tables

Millmen who have spent a lot of time figuring roll capacity by means of the complicated diagram charts usually employed, will appreciate the new and original table of roll-capacities contained in the new Buchanan Bulletin on Type "C" Crushing Rolls. By the use of these tables any operator can quickly determine the size, speed, and number of rolls necessary to do a given amount of work.

The Buchanan Company builds crushing rolls in sizes from 18″ x 12″ up to and including 72″ x 30″. Their experience in building high-grade crushing equipment dates back many years—a record of the production of quality products known for careful workmanship and consistent, satisfactory service.

Bulletin 13, on Type "C" Crushing Rolls containing the new capacity tables will be gladly sent upon request.

C. G. Buchanan Co., Inc.
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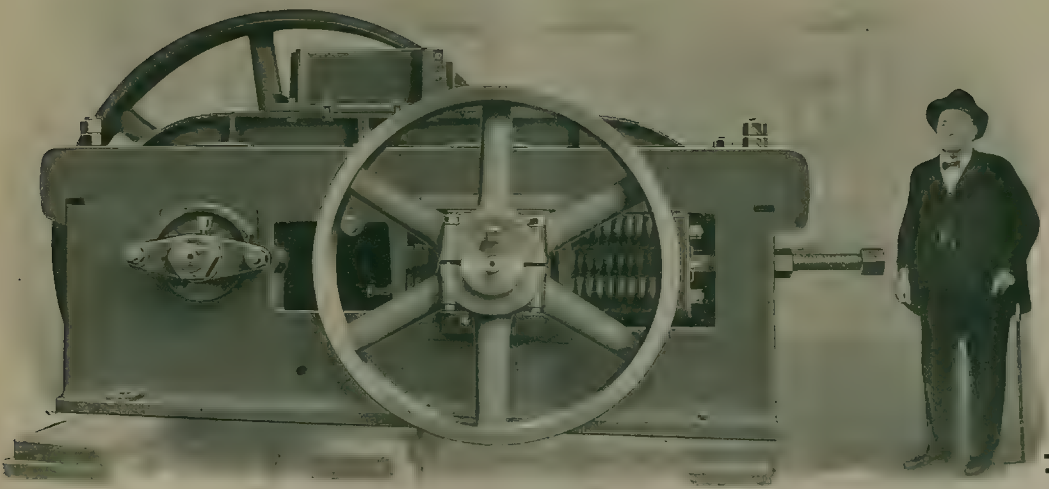

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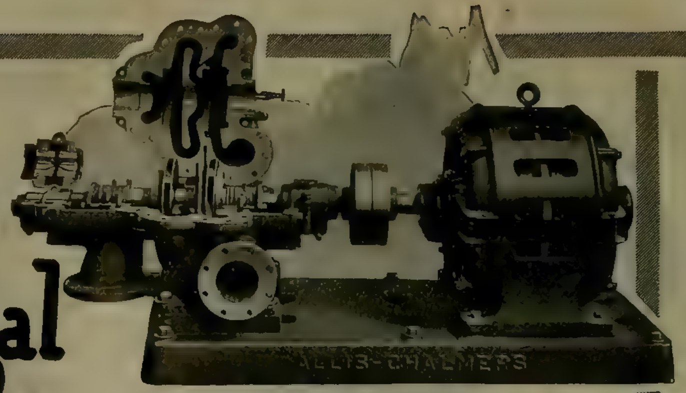

Centrifugal Pumps for Mines

ALLIS-CHALMERS
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The extensive adoption of Allis-Chalmers Centrifugal Pumps by the Mining Industry is a striking testimonial of their adaptability to mining conditions. Many of the largest mines operate Allis-Chalmers Centrifugals, which are rapidly displacing other types. Special bronze pumps are operating very satisfactorily with acid water. Some pumps are being used to discharge against heads up to 1000 feet.

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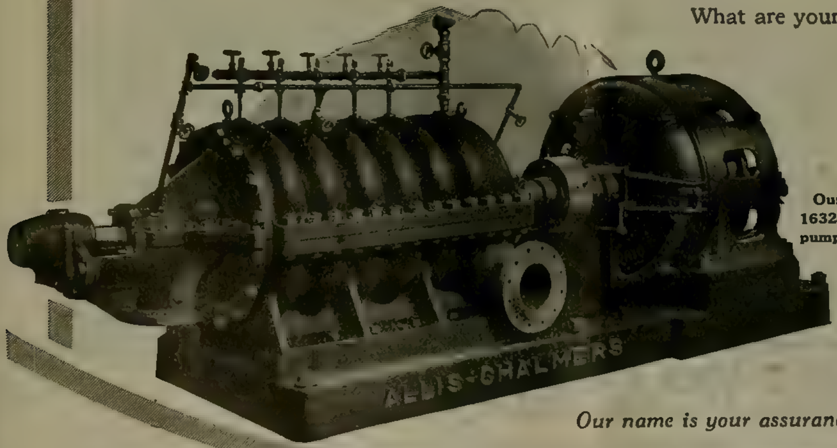

Our Centrifugal pump bulletin 1632-E describing our standard pumps will be sent on request.

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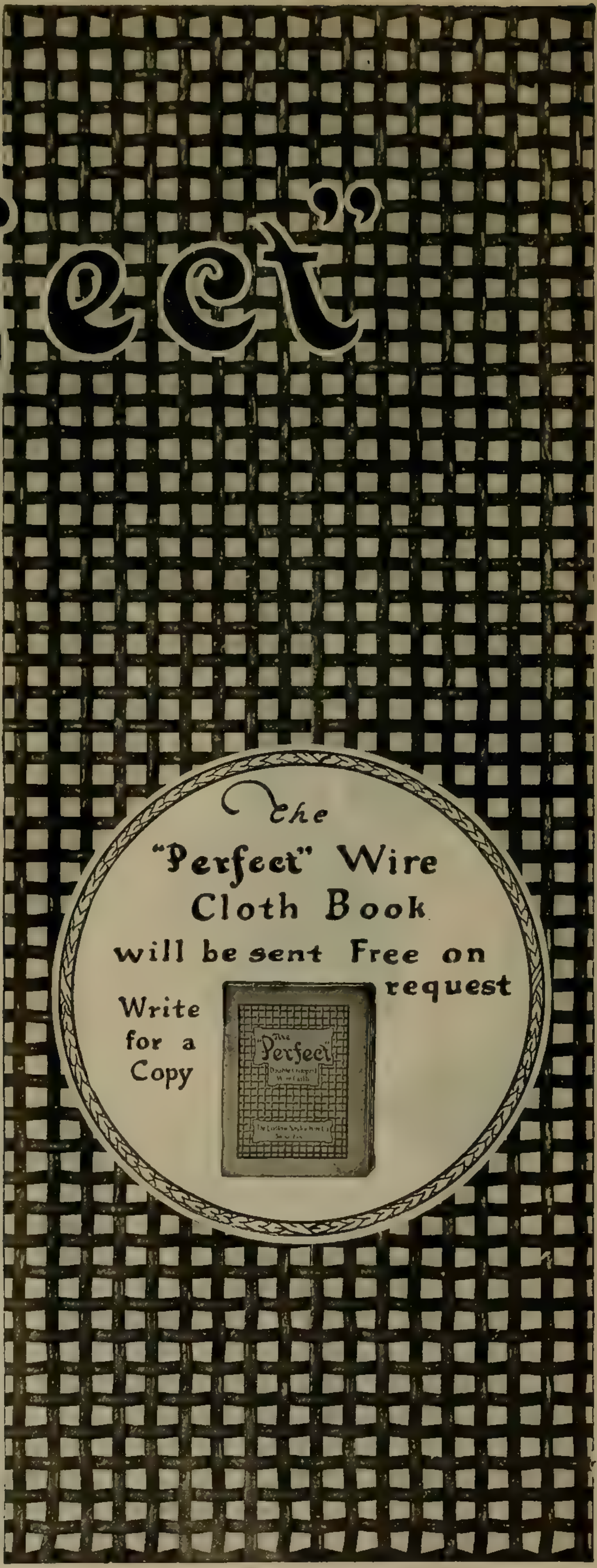

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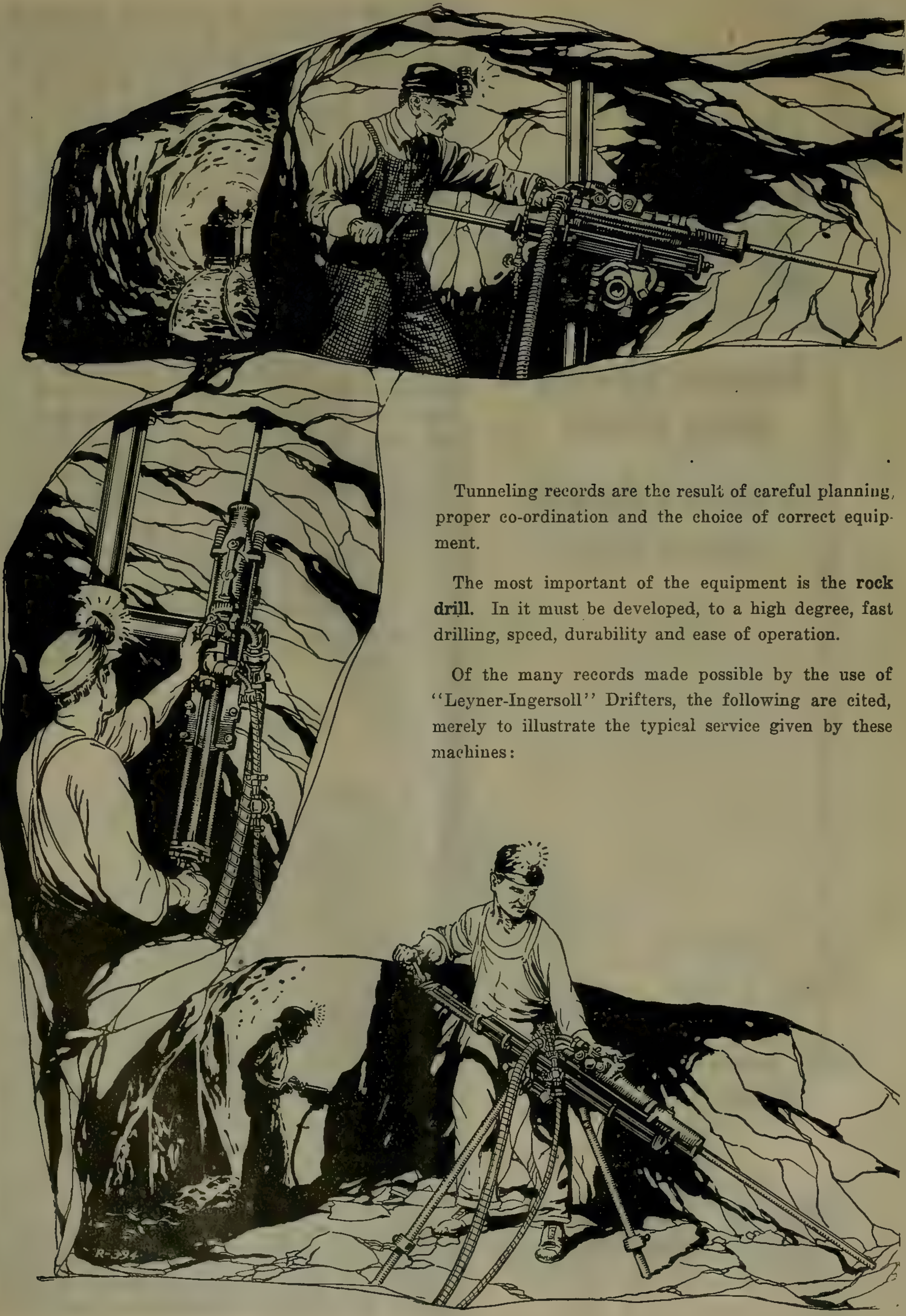
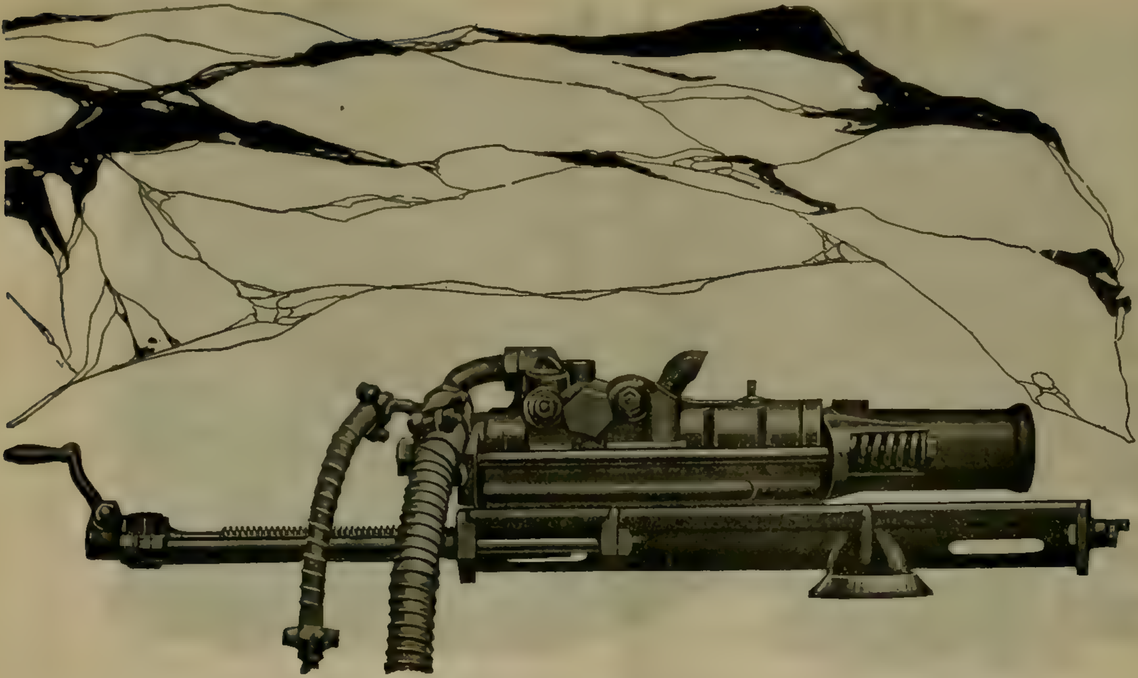


Tunneling records are the result of careful planning, proper co-ordination and the choice of correct equipment.

The most important of the equipment is the **rock drill**. In it must be developed, to a high degree, fast drilling, speed, durability and ease of operation.

Of the many records made possible by the use of "Leyner-Ingersoll" Drifters, the following are cited, merely to illustrate the typical service given by these machines:



In the Priest heading of the Hetch Hetchy Water Supply Project (City and County of San Francisco) 776 feet advance was made in 93 shifts (31 consecutive days) driving an 11 ft. 3 in. section tunnel. That is good speed performance. No. 248 Leyner-Ingersoll Drifters were used.

At the Imperial Mining Company, Wallace, Idaho, another No. 248 Leyner-Ingersoll Drifter drove 870 feet of 5′ x 8′ tunnel through Burke and Revett quartzite (which required 16 to 18 holes to break the ground). The complete repair cost was $10.80 or 1¼ cents per foot advance. This is good durability performance.

The consistent excellence of Leyner-Ingersoll Drifters has caused their adoption on such undertakings as the Southern California Edison Company's immense hydro-electric projects on the west coast and on the Catskill Aqueduct Extension on the east coast.

Data accumulated from record sheets of rock drill users has given Leyner-Ingersoll Drifters an enviable reputation for doing more work at less cost.

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The severe mine conditions to which Cameron Pumps are often subjected bring out their many dependable features of design and construction. For many years Cameron Pumps have been proving themselves equal to the hardest requirements of mine service either underground in the sump or in the power house on the surface.

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One of these types, Class "MT" Multi-stage Centrifugal Pumps, is particularly suited to high head service conditions. Cameron Class "MT" Pumps are built in from two to five stages in a single unit and up to ten stages where two pumps are arranged in series. Their capacities range from 125 to 11,000 gallons per minute, for heads as high as 1400 feet.

Write for Bulletin 7351

Ingersoll-Rand Company
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144-DV

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You May Never Have to Build a Dam—

But when a big contractor gets the job of building a city's water supply, or a hydro-electric development—

He has so many conditions to meet, including time-limits and such—

He must know—beyond a doubt that his crushing equipment is dependable—

As mill operators your problem is not so very different—

And that's why we tell you that—

TRAYLOR CRUSHERS

long ago demonstrated their superiority for use in connection with dam building.

If the list of users shown in the column opposite means anything, it means that TRAYLOR exclusive features, have proved up in the test of hard service.

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Southern Office:
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South-Eastern Office:
C. B. Davis Engineering Co.,
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Birmingham, Ala.

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Kensico Dam,
Valhalla, New York

Mitchell Dam,
Verbena, Alabama

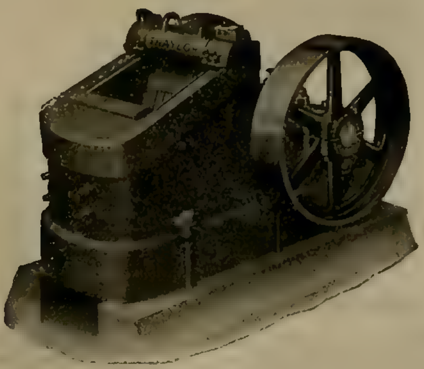
Loch Raven Dam,
Baltimore, Maryland

Chippewa-Queenston Development Hydro-Electric Power Commission of Canada

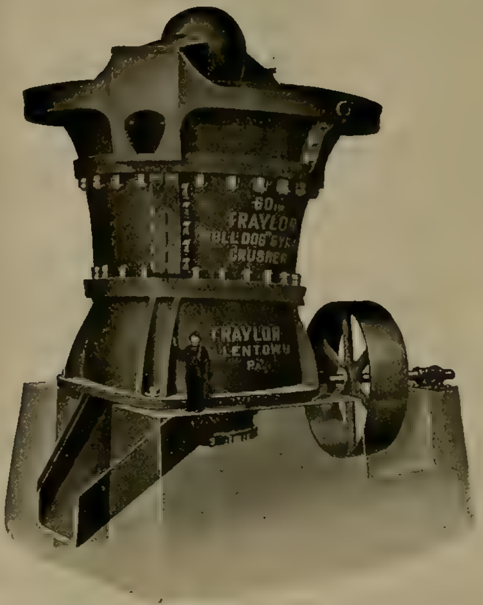
Cedar Rapids Power & Mfg. Co., St. Lawrence River Development

Gilboa Dam,
Gilboa, New York

AND OTHERS



BULLDO JA CRUSHER
BULLETIN JX-1



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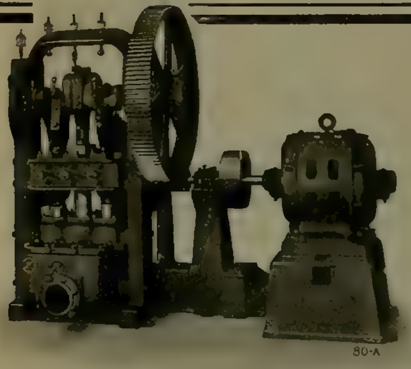
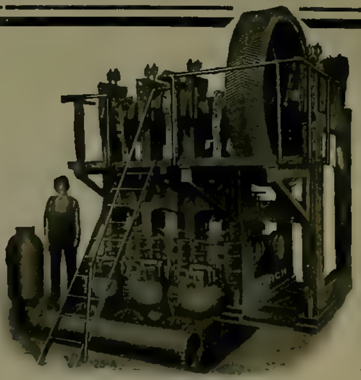
Aldrich Power Pumps For Mines And Mills


"No Waster's Penalty"


Aldrich YDRANGE Triplex

Aldrich Triplex

WHAT happens when pumps fail to measure up to proper efficiency ?

Just then you commence to pay a "Waster's Penalty".

It's just as real as if it appeared in big red figures on your power bills each month. Tangible losses are easily checked but the energy-drain of inefficient pumps piles up penalties all along the line from sump to coal-pile.

Cutting the "Waster's Penalty" may mean the difference between profit and loss in the operation of your mine.

Aldrich Quintuplex and Triplex Power Pumps develop and maintain for continuous service, an efficiency up to 90%. They give real insurance against a "Waster's Penalty" all the way back to the fuel you burn.

Get the facts on what a new Aldrich Pump—to fit your exact need—could do in your mine. Aldrich engineers will gladly advise on any installation. PUMP DATA 50 is a folder full of the sort of information needed to check up by. It will be gladly sent on request.

The Aldrich Pump Company

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Chicago El Paso New York Philadelphia Tulsa Pittsburgh

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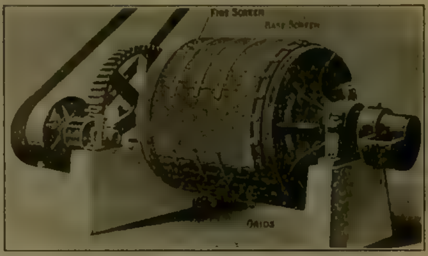
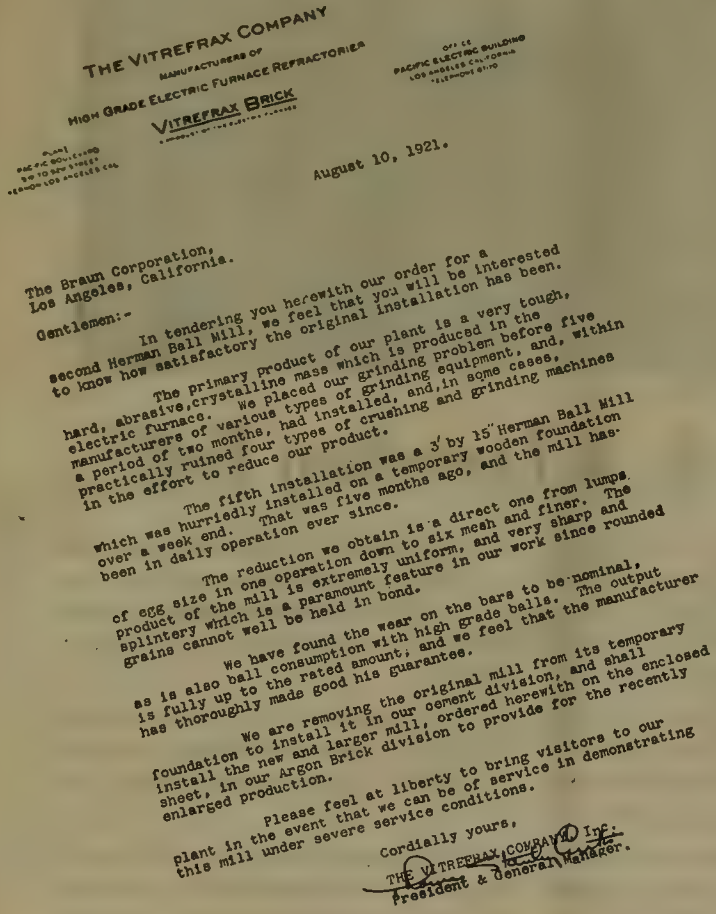
"We feel that the manufacturer has thoroughly made good his guarantee."





THE VITREFRAX COMPANY
MANUFACTURERS OF
HIGH GRADE ELECTRIC FURNACE REFRACTORIES
VITREFRAX BRICK

August 10, 1921.

The Braun Corporation,
Los Angeles, California.

Gentlemen:-

In tendering you herewith our order for a second Herman Ball Mill, we feel that you will be interested to know how satisfactory the original installation has been.

The primary product of our plant is a very tough, hard, abrasive, crystalline mass which is produced in the electric furnace. We placed our grinding problem before five manufacturers of various types of grinding equipment, and, within a period of two months, had installed, and, in some cases, practically ruined four types of crushing and grinding machines in the effort to reduce our product.

The fifth installation was a 3' by 15" Herman Ball Mill which was hurriedly installed on a temporary wooden foundation over a week end. That was five months ago, and the mill has been in daily operation ever since.

The reduction we obtain is a direct one from lumps of egg size in one operation down to six mesh and finer. The product of the mill is extremely uniform, and very sharp and splintery which is a paramount feature in our work since rounded grains cannot well be held in bond.

We have found the wear on the bars to be nominal, as is also ball consumption with high grade balls. The output is fully up to the rated amount; and we feel that the manufacturer has thoroughly made good his guarantee.

We are removing the original mill from its temporary foundation to install it in our cement division, and shall install the new and larger mill, ordered herewith on the enclosed sheet, in our Argon Brick division to provide for the recently enlarged production.

Please feel at liberty to bring visitors to our plant in the event that we can be of service in demonstrating this mill under severe service conditions.

Cordially yours,

THE VITREFRAX COMPANY Inc.

President & General Manager.

That is what one user says in placing his order for another

HERMAN

Patent Screening Ball Mill

(Peripheral Discharge)

Read his letter. He ruined four types of grinding machines. Then the **Herman Mill** came on the job—and his troubles were ended.

Whatever your grinding problem may be, the **Herman Mill** will solve it efficiently and economically. It is simple and sturdy in construction, and scientifically correct in design. Wearing parts are few, and easily replaceable.

With the **Herman Mill** there is no oversize to be reground. The pulp sifts out of the mill and passes direct to plates or tables.

The mill is made in sizes ranging from 2 tons to 225 tons daily capacity, and in prices ranging from $400 to $4000.

There is a **Herman Mill** for every grinding purpose. Let us give you complete data. Ask for Bulletin S193.

SOME FEATURES

Heads of finest alloy chrome steel. Reversed grizzly grids of manganese steel—no peening, no plugging. Grids made in sections and bolted and locked with Drake Lock-nuts, accessible from the outside. Sections of grids easily removable, without disturbing other sections. Screen can be changed quickly. Ample discharge area.

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How Tough Is A Leviathan Belt?

HERE is a 30"x 8-ply Leviathan belt 300 feet long that has been carrying 700 tons of rough, jagged slag every day for over four years. The pieces of slag vary in size from tiny pieces up to chunks a foot and a half thick and travel up a 20° incline from railroad hoppers to crusher.

Of course this remarkable performance is partly due to the Style F Main Belting Rollers but it shows what can be done when you get the right belt and the right rollers working in proper combination.

There are so many hundred instances where Leviathan and Anaconda have surpassed the best performances ever obtained with any other kind of belts that, regardless of your present opinions, you certainly should at least investigate our record, claims and guarantees.

We have prepared two really worth while booklets on belting—"Transmission Belts" and "Conveyor Belts". May we not mail you one, or both?

For every 1% a belt stretches after the first cut, the Main Belting Company will refund 3% of the purchase price. The first cut is excepted merely because it is generally recognized that it it more a matter of taking up slack than taking out stretch.

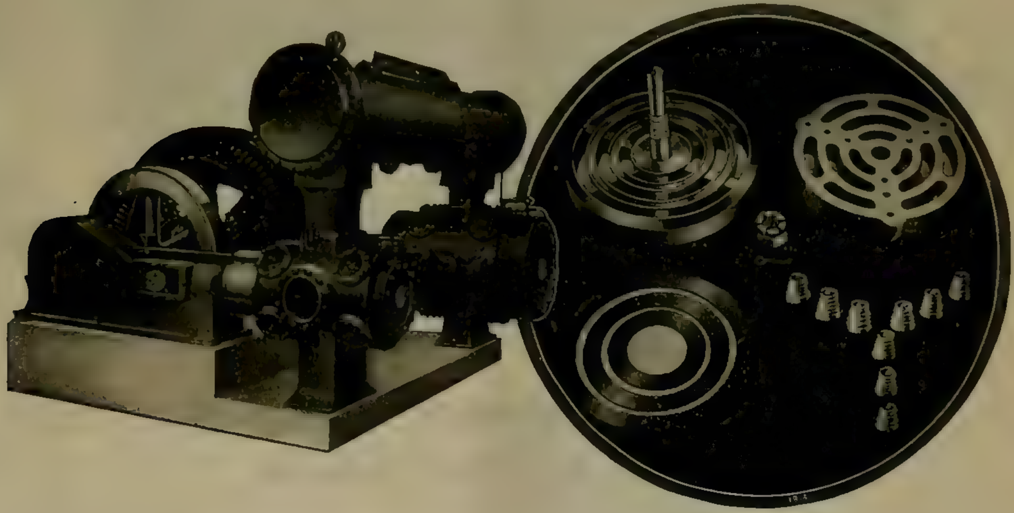
LEVIATHAN AND ANACONDA
GUARANTEED AGAINST STRETCH
BELTING

MAIN BELTING COMPANY
PHILADELPHIA
New York Chicago Pittsburgh Atlanta San Francisco

THE SATISFACTORY PERFORMANCE OF CP COMPRESSORS

SIMPLATE VALVE

RESULTS FROM THE "FINE POINTS" OF THEIR DESIGN



EXPERIENCED users of air power, recognizing the fact that the heart of any compressor is its valves, and that valve-failure means compressor-failure, are directing serious attention not merely to valves but to the "fine points" of valve construction.

There's a big difference, for example, between *port* area and *valve* area. Port area is the area through the port. Valve area is the area between the seats; that is, the distance of the lift times the length of the opening equals the valve area.

A valve may have a very large port area but a very small effective area. Hence, the importance of selecting SIMPLATE Valves which feature a straight lift and an unrestricted valve area, thereby providing effective valve area.

SIMPLATES are the original concentric-disc independent plate valve! They do not bend or twist, but lift straight up, rising equally and simultaneously on all sides. No whipping, bending or chattering to cause breakage or noise.

Their effective valve area is the entire circumference of the valve—a "fine point" worth considering from a dollars-and-cents standpoint when buying your next air compressor.

C-P Air compressors are built in over 500 sizes and types — *all* modern. Capacities, 20 to 10,000 cubic ft. per minute. Ask for Bulletins.

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C-95

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CHICAGO · CHICAGO CP PNEUMATIC · PNEUMATIC

The Compressor with the Simplate Valve

Increasing Tonnage with the Newest of Drill Steels

It had to come! In the Tool Steel using fields (other than the metal working mines) it is the great improvements in Tool Steels that have largely made possible America's "big production at low cost."

Red Star VANADIUM Drill Steel

Now, for the first time, the mining world has available a Drill Steel possessed of the characteristics of the fast-working, long-lasting metal cutting Tool Steels.

Vanadium gives steel increased hardness, density, endurance. Red Star Vanadium seems destined to do for mining what alloy steels have done for other industries—"bigger production at lower cost."

Never, in the history of mining, was greater necessity for the development of this newest of drill steels. There are rigorous demands for economy, for greater tonnage, for decreased production costs.

Making none but Tool Steels, and developing RED STAR VANADIUM as we have, our faith is great in its achievements—on the results it will bring in your mine.

Any of our warehouses below can immediately fulfill your initial requirements. Repeat orders, for quantity, are taken care of in the sequence received.

Colonial Steel Company

Pittsburgh **New York** **Chicago** **St. Louis** **Birmingham**
Denver **Salt Lake City**
EDW. L. SOULÉ CO., San Francisco

LUNKENHEIMER
"Duro"
Blow-off Valves

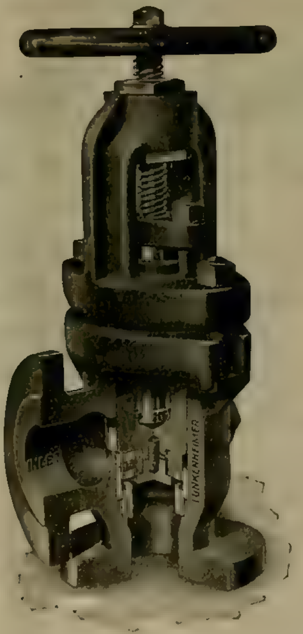

Fig. 897, Flange Ends
Fig. 896, Screw Ends

"Duro" Blow-off Valves prevent heat waste in blow-off valves. They remain tight under extreme operating conditions because they are not only made of wear-resisting materials, but their design is such that the usual causes of leakage are eliminated.

The piston-shaped disc secures a gradual release of the water due to its travel in the cylinder above the seat before full open position is reached. And when closing, the seating surfaces are automatically cleansed by the fine stream of water forced past the disc as it travels through the cylinder casing before seating. This action also minimizes wire drawing of the seat.

"Duro Blow-off Valves contribute to efficiency and economy in plant operation and meet every blow-off requirement. Sizes 1¼ to 3 inches, in Iron Body Bronze Mounted Pattern for pressures up to 250 pounds.

Specify "DURO" BLOW-OFF VALVES and insist on their installation.
Write for catalog No. 58-CD

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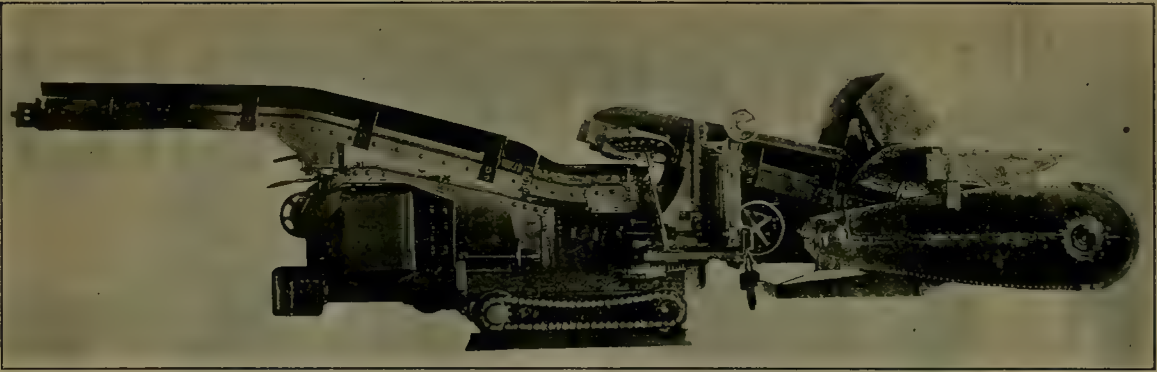

No. 4 Size Myers-Whaley Shoveling Machine

Myers-Whaley Shoveling Machines

ARE STANDARD EQUIPMENT IN MANY MINES AND TUNNELS

Able to work in 5′ 6″ headroom, muck out a 7-ft. entry, or clean up a 20-ft. room from a single track, the Myers-Whaley averages a ton per minute of actual loading time. Machine is self-propelled at the rate of 70 feet per minute and can readily be moved from one working place to another.

BELOW ARE A FEW REMARKS FROM USERS:

"We have had one of your mechanical loading machines in use in our mines at Retsof, N. Y., since the latter part of March. As a loading machine it is a perfect success. Our average loading during this time has been from 250 to 300 tons per day, of nine hours."

Machine used handling rock salt. Letter written in 1913. This company has since purchased 7 more Myers-Whaleys.

"The shovels are used to open up new slopes and usually do their own tramming to the hoistway. The work which they have to do is the most severe possible in mining, owing to the excessive weight of the material handled and the large chunks. . . . During times of labor shortage or of high wages, they have been of almost inestimable value to us."

Four Myers-Whaleys are used in this magnetic ore mine. Letter written in 1921.

"We have examined all the shovels and like the Myers-Whaley shovel best of all."

"At the present time we have in use in connection with the tunnel driving of the Mountain Aqueduct 13 of the No. 4 Myers-Whaley machines. This machine is standard with us on all of our tunnel work where the tunnel driving is conducted from portals or adits. . . ."

The first quotation from letter written in 1920, second quotation from letter written in 1922. The character of material handled ranges from slate to coarse, blocky granite. Tunnel length is 18 miles.

"The machine has been in continuous operation since the day it was assembled. . . . During this period of time the machine has not been out of commission nor lost any operating time since the date of its installation. . . . I may further state that the operation of the machine has been and is at the present time entirely satisfactory to us."

Machine referred to above is loading coal and was installed in August 1921. Letter written in 1922.

"We have been using your machines some five years with very satisfactory results. We operate three of these machines about nine hours per day and load on an average about 800 tons of limestone. We figure that these three machines load as much as thirty-two men hand loading."

Machines used for loading limestone in underground quarry. Letter written in 1922.

For Catalogue, Treatise and Data on Operations Similar to Your Own Mention Your Conditions When Writing

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SAN FRANCISCO, MARCH 25, 1922

$4 per Year—15 Cents per Copy

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It sees in each of the forty-six Linde Warehouses now in operation not merely a distribution centre, but a producing plant—fully equipped to make Linde Oxygen.

Indeed with the exception of our original plant all of the twenty-nine Linde Plants which supply American consumers today were originally storage places.

Every warehouse is carefully located with a view to adequately meeting the needs of oxygen users as the use of the oxy-acetylene process develops in that territory.

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1750-22

T. A. RICKARD, ... Editor

Farewell and Hail!

In our issue of March 4 the Dewey Publishing Company, by its president, announced the consolidation of this paper with the 'Engineering and Mining Journal', and the continuance of the two papers under the name of the 'Engineering and Mining Journal-Press', to be published by the McGraw-Hill Company of New York. This is the last issue of the 'Mining and Scientific Press', as a separate unit, and the occasion calls for a few words of explanation. My statement as publisher was formal; as editor I can be more personal. I became publisher of the 'M. & S. P.' simply for the purpose of being an independent editor. Gentlemen, the days of the editor-publisher are gone, and most of you are aware of the fact. The growing size and complexity of modern business, especially in a continental territory such as the United States, render necessary a degree of organization and an amount of capital beyond the reach of the kind of man that is fitted to be an editor. The mining industry, including the manufacturers that supply it with machinery and material, demands services that can be performed only by a large organization. Therefore it seemed to me wise to join with Mr. James H. McGraw in consolidating the two papers, thereby giving the United States a national mining paper better than anything that has gone before.. If the plan had been merely to buy the 'M. & S. P.' and kill a competitor, I would have rejected the proposal without hesitation, but when the idea was suggested of merging the two papers for the purpose of publishing a national paper worthy of the most important mining region in the world, I acquiesced cheerfully. For 17 years I have controlled the 'M. & S. P.' and have endeavored to make it useful first to the mining profession and then to the mining industry as a whole; I believe that I am serving the best interests of the profession and the industry alike in effecting the consolidation and in becoming associated with the consolidated publication, in order that I may continue to express the ideas and record the achievements of the men of the West. The editorial staffs of the two papers will be united under the leadership of Mr. Spurr, who remains in New York, while I become contributing editor with residence in San Francisco. Thus the two independent technical papers will be joined, and will be in a strong position to face the unfair competition of the pseudo-journalism of the American Institute and the Mining Congress, both of which are printing periodicals the support of which is based upon an untruth—the statement that their members are 'subscribers'. I bespeak the support of the subscribers of the 'M. & S. P.' for the 'Journal-Press', feeling confident that they will receive a better paper, at the same cost, and that the mining men of the West, more particularly, will continue to receive the friendly consideration to which they have been accustomed in a paper that they regarded as 'their own'. In short, Gentlemen, this is not a funeral, but a wedding; so while I saw farewell as editor of the 'M. & S. P.' I bid you hail as contributing editor of the 'Journal-Press'.

T. A. RICKARD.

March 25, 1922.

VALUE of the output of the two principal precious metals in Mexico during 1921 is given by the Secretary of Industry and Commerce as follows: gold, 21,275 kilogrammes, or 683,986 ounces; silver, 2,005,143 kilogrammes, or 64,464,705 ounces. The 1920 output was: gold, 735,093 ounces; silver, 66,517,804 ounces.

REFERRING to the article on 'Glass' by Mr. P. B. McDonald in our issue of March 11, our attention has been drawn to a note on the subject of the amethystine coloration, in a short paper by Mr. A. R. Riddle in the Transactions of the Royal Society of South Australia. Bottles that had been exposed to the sun of the desert-lands showed tints due to the effect of solar ultra-violet radiation. Experiments showed that it was caused by a change in the chemical state of the manganese in the glass, and it disappeared when heat was applied.

A PRESS AGENCY, in England, recently sent to us, unsolicited, a series of photographs. Our attention was attracted to one of these, which purported to picture "A New Process for Separating Fine Metals from Their Ores," the description of which reads as follows: "It is claimed for this invention . . . that 95% of fine metal can be obtained from the ore, thus eliminating much loss. Known as the 'Flotation' process, the ores have added to them a small quantity of oil. The resulting froth comes to the top with the metal and from this the required residue can be extracted". The mysterious reticence of the Minerals Separation company has failed —in England, at least!

PROFESSOR Taggart's 'Manual of Flotation Processes' was reviewed in our issue of March 4, but we neglected to give the correct designation of the publishers, Messrs. John Wiley & Sons, of New York. We make the correction gladly and appreciate an opportunity to draw attention again to an excellent treatise on the subject.

IN a recent issue we referred to the alleged extraction of gold from the water in Mono lake, and the action of the local Court in dismissing a suit brought by a widow for the return of $2000 that she had subscribed to the venture, which is promoted by a local photographer. In a press dispatch of later date we read that two men are under arrest at Portland, Oregon, on the charge of selling stock in this iridescent venture. We hope that this time the Court will be less complacent.

OWING to the strike on the Witwatersrand, Great Britain arranged recently for the shipment of gold valued at about $800,000 from the United States to India. The price in pounds paid for the metal was equivalent to that paid, including the currency premium, for the gold produced in South Africa. This fact indicates the absurdity of supposing that the companies operating in the British possessions ever received preferential treatment, or that the premium was anything more than an adjustment to correct the depreciated value of the British pound.

PRACTICAL instruction is the aim of professors of mining, and that is why several Schools of Mines have availed themselves of abandoned mines as a means for bringing the students into close touch with actual mining operations. We publish a description of the mine utilized for this purpose by the Missouri School of Mines at Rolla. Mr. C. R. Forbes, the Professor of Mining, is the author. His article reminds us that the Camborne School of Mines, in Cornwall, operates a complete tin mine, named the 'King Edward', and we have heard that it serves its intended purpose admirably. We have no doubt that our friends in Missouri will make good use of their domestic mine.

REVISED statistics for the gold production of the Transvaal show that in 1921 the tonnage crushed was 23,746,988, yielding 8,114,486 ounces of gold, worth £41,944,797. These figures show a decrease, as compared with 1920, of 724,400 in tonnage, 40,000 in ounces of gold, and £1,188,300 in value. The so-called profit is stated to be £11,250,000, which is £300,000 less than the previous year. At the normal price of 85 shillings per ounce the gold output of the Rand itself would have been worth only £33,681,250, so that the so-called premium amounted to £7,510,600, which was £350,000 more than the total of dividends. The average yield was 28s. 8d. per ton, or exactly 3 shillings above the average working cost. The currency premium amounts to 6s. 5d. per ton, therefore at the normal price of gold there would have been a loss of 3s. 5d. per ton on the tonnage mined and milled during the year. It is evident therefore that the prosperity of the Rand depends entirely upon the adventitious aid given by the discount on the paper pound sterling.

BECAUSE of increased cost of production, the efficient burning of coal is of greater importance than it was before the War. The need for exhaustive examination of new methods of utilization, to determine actual work done per pound of coal used, is imperative. Mr. H. S. Denny, well known in South Africa as a metallurgist, and the staunch supporter of all-sliming treatment for gold ores, and Mr. N. V. S. Knibbs recently presented a paper at a meeting of the Institution of Mechanical Engineers on the operation of a large producer-gas power-plant in England. The equipment available, unfortunately, was out of date and inefficient; and the conclusions were unfavorable. However, valuable data have been prepared that will serve as a basis for further discussion. . The British government invited Messrs. Denny and Knibbs to make the tests; and, although conditions were abnormal, the task was undertaken, with an appreciation of the disadvantage. The results are of interest, but not indicative of what may be possible under normal and favorable operations.

AT no time in recent years has Congress expressed the public opinion of the nation so inadequately and incorrectly. The people of the United States want the Senate to ratify the agreements made by our representatives at the Washington Conference and they deplore the way in which both houses of Congress are playing with the soldier bonus while keeping an eye on the forthcoming elections. By every test of public opinion, particularly as expressed by thoughtful men in the community, and even by less thoughtful newspapers, it is the desire of the people that the doings of the Conference be ratified by the Senate. It is a sad commentary on our political institutions that the Democratic senators should oppose the agreements made by President Harding's administration just because the Republican senators two years ago declined to ratify President Wilson's agreements with the foreign governments. In this matter the President and Mr. Hughes have the backing of our people; the agreements they have submitted to the Senate voice the national intent to guard against war and to promote peaceful industry. The administration at Washington has done the world a signal service. The nullifying of that service by party politics will provoke deep resentment.

ELECTRICITY has scored another triumph as the servant of man. On February 2 a section of the 36-inch cast-iron water-pipe connecting Brooklyn with Staten Island in New York harbor, was broken, apparently by the spud of a dredge. The flow of water into the sea amounted to about 28 million gallons per day, and the position of the break was determined by pumping compressed air into the pipe. The depth of water at the point was about 50 feet. Divers were then sent below to remove a cover of silt, a task that took about three days. These details are from an interesting account by Mr. W. W. Bush in a recent issue of 'Engineering News-Record'. It was found desirable to cut away about 15 feet of the pipe. Experiments were started immediately by Merritt & Chapman, the contractors, to prove the practicability of using an electric torch under water for the purpose. The result was favorable. The cast-iron pipe was cut in about nine days and was then replaced by a new length. The burning was done by means of a special torch, invented by Messrs. R. E. Chapman and J. W. Kirk, and consisting, essentially, of a carbon electrode bored for the passage of the cutting gas, oxygen. The carbon is connected with one pole of a generator, the other pole being grounded through the water to the metal to be cut. An arc is formed by making contact and by withdrawing the electrode in the usual way, the water being then displaced from the neighborhood of the cut by the gases formed. The achievement suggests still another use for electricity and oxygen; it indicates the fertility of American inventive genius.

STATISTICS dealing with accidents at metallurgical plants in the United States during 1920 have been issued recently by the U. S. Bureau of Mines. The figures indicate a reduction in number of 3 fatalities and an increase of 737 injuries as compared with 1919. The accident-rates, based on a standard of 300 working days per annum, were 0.97 killed and 140.42 injured per 1000 men employed, as against 0.99 killed and 126.26 injured during 1919. These figures were proffered without comment as to the increase in the number of accidents during a period when safety-first measures were being advocated and practised to a much greater extent than formerly. We have examined the data in detail and find that the proportion, per 300,000 man-shifts, of employees that were injured in ore-dressing plants has increased, with minor fluctuations, from 94.19 in 1914 to 164.24 in 1920. During the same period the number, also per 300,000 man-shifts, of men injured in smelting plants, excluding iron blast-furnaces, has fallen from 175.44 to 142.33. During the period under review there has been an increase in the use of mechanical appliances in ore-dressing plants, whereas no equivalent change has occurred in smelters; but the real reason for the increase of accidents in mills is due, we believe, to the fact that so many of them are controlled by comparatively small companies, which cannot afford safety-first departments. The smelters, on the other hand, are usually under the control of wealthy and influential corporations, all of which consider the safety inspector and his staff as an essential feature of their organizations. If this explanation be the correct one, it would appear that much good might result from an educative campaign by the technical press and the professional societies, coupled with a spirit of co-operation on the part of the larger corporations, which might arrange, at small cost, to distribute their safety-first literature among the less wealthy and less influential units of the mining industry.

SPREADING of risks in mining is wise, and that is why many so-called exploration companies find it advisable to take an interest in a variety of ventures. For example, the Mexican Corporation is an English company controlling a subsidiary of the same name in Mexico, which in turn owns the Tezuitlan Copper Company and operates the Fresnillo silver mines, in Zacatecas. In addition, the Mexican Corporation took a 'participation' with other mining houses in London upon the Union en Cuale, a large concession covering zinc, silver-lead, and gold mines in Jalisco, on the west coast of Mexico. Another interest held by the same corporation is a block of stock in the British Equatorial Oil Company, which is operating in Venezuela. The Fresnillo deal was of an unusual character in that the Mexican Corporation agreed to equip the property with a mill of 60,000 tons monthly capacity in consideration for 40% of the company's net earnings and the management of this enterprise for a period of 25 years. Owing to the unexpectedly large increase in the cost of machinery and materials, the cost of the mill far exceeded the estimate; thereupon the royalty to be paid was increased to 20% more of the net profits. At the same time the Mexican Corporation agreed to enlarge the mill so that it could treat 75,000 tons instead of 60,000 tons per month. After the cost of the mill has been liquidated, by the royalty, the remaining profit is to be divided equally until a total sum of $5,000,000, including the $800,000 spent on the mill, has been received by the Mexican Corporation. When this has been done, the Corporation and the Mexican owners of the Fresnillo revert to the original basis of division, namely, 60% to the Mexican owners and 40% to the Mexican Corporation. The chairman is Mr. Frederick W. Baker, a lawyer by training but a sagacious promoter by occupation.

Philip Argall

We record the passing of Philip Argall, on March 19, at Denver, with deep regret, softened, however, by a recognition of the fact that in his life of 68 years he proved himself a good citizen and a highly useful engineer. His career was reviewed in the interview with him that we published in our issue of January 22, 1916. That record shows that he started life under many disadvantages, that in large measure he educated himself, that he continued to be a student always, that he had initiative and persistence, that he was a keen technician and a successful metallurgical engineer. In private life he showed the qualities of the highest type of citizen; he was sociable, but not gregarious, so that he spent his spare time at home, from which he gave to his adopted country a group of young men and young women of whom any father might be proud. He made the most of his opportunities and contributed to the welfare of mankind.

The Genoa Conference

The international meeting at Genoa was postponed to April 10 on account of the defeat of the French Premier, M. Briand, who, with Lloyd George, the British premier, had planned, at Cannes, to convene this economic conference in March. The postponement was not made for the purpose of securing the presence of American delegates; it was necessitated by the exigencies of European politics. On the other hand, it is certain that most Americans would like to help the peoples of Europe in their efforts to restore normal economic conditions; and in their desire to help, most of our people are without partisan sympathy; that is, the fraternal feeling engendered by association with the Allied powers during the War has cooled and they are almost as desirous of seeing Germany and Austria rehabilitated as any other country in Europe. However, they are without the knowledge needed to give intelligent support to President Harding and his administration; public opinion is not sufficiently well informed to back American participation in the conference at Genoa, and without it any action that our delegates might take would be rendered futile by the obstructive tactics of a misrepresentative Senate. That is the weak point in our position toward European reconstruction. Next, it is doubtful whether the United States can help the Europeans until they take stock of their conditions and make a more systematic effort to help themselves. So long as the question of German reparations remains unsettled, and so long as French militarism is in the ascendant, it is useless for anyone on the outside to offer help.

We believe that the United States was right in declining the invitation of Italy to participate in the Conference. The chief reason, as stated by Secretary Hughes, was that the Conference is "of a political character", such as would cause the United States to be "involved in European political questions". Moreover, our Government does not approve the proposed treatment of Russia as a German preserve—"the obtaining of economic advantages in Russia which would impair the just opportunities of others"; in short, the United States stands for the open door in Russia as well as in China. Another reason for declining the invitation was not expressed explicitly, but it has been stated semi-officially at Washington; it is that the large military forces maintained by the European governments constitute the chief cause of the sad economic plight of their peoples and that without a drastic reduction in the size of their military establishments it is useless to attempt any economic rehabilitation. The cost of maintaining large armies on a war footing is only part of the burden; the worse result is the incitement to international resentments and the maintenance of obstructions to international commerce. So long as the European nations choose to live in the atmosphere of a cat-and-dog fight, it is useless for any friend on the outside to proffer help. Our people have had enough of war and they intend not to be drawn into any more international conflicts. That is why the Washington conference succeeded, and why even the Senate has been impelled to ratify the pacts resulting therefrom. We repeat, it is the general desire of the American people to seek counsel with Europe and take part in the task of reconstruction, but American participation must be free from political entanglements. For example, President Harding, like President Wilson, is adverse to the recognition of the Soviet régime. It is believed that economic prosperity in Russia is impossible under the rule of Lenin and his band of pirates. Whatever sympathy one may have for the Russian people, it seems unlikely that the recognition of their present rulers would help. It would not establish "the essential basis of productivity", as Mr. Hughes says; on the contrary, it would fix the plague-spot on the map. Lenin's guarantees are worthless; they are given with the tongue in the cheek; moreover, he and his companions are pestilential in their propaganda all over the world, preaching a spirit utterly destructive to our ideas of civilization; they merit the treatment meted to bubonic rats. Other obstacles to the success of the conference at Genoa are the German reparations and the Allied debts. Trade in Europe—or elsewhere—can not prosper so long as German industry is overshadowed by an indefinite burden; it is to the benefit of all, especially France, that the burden be fixed at an amount that Germany can carry without being crushed, but not so lightly as to cause her to forget her sin against humanity. The question of the Allied debts is another obstacle to normality of international intercourse. It is a difficult question. We appreciate the Allied viewpoint that the money they borrowed was spent to wage the War into which we entered belatedly and in which they had fought for what proved to be our cause; that they have suffered more than we have, and that we ought to set our dollars against the lives of the young men that they lost before we gave them our assistance in preventing a calamity even greater than the War itself. The sums we loaned were spent largely in the United States, in the purchase of munitions and supplies; in fact, they borrowed food and war materials rather than money. We came out of the War with a total loss of life no more than any one of our Allies suffered in a single day; we were tremendously enriched by the War; we can afford what the French call a fine gesture, and wave aside the obligations due to us, especially as only the British debt is likely to be paid and the cancellation of all the debts would do more to promote goodwill and restore international trade than any number of speeches and editorials. In any event, it is clear that the invitation to be represented at Genoa has had a beneficial effect in causing a general discussion in our daily and periodical press of our attitude to Europe and in developing the idea that we ought to help because our fate is linked with that of those who suffered from the War much more than we did. The United States is not an island in the Pacific—a Yap or a Guam—but a big brother in the fraternity of nations, and, within recognized limits, it is our duty to give both brains and money for a concerted effort to repair the ravages of war, and to restore commerce and civilization in the Old World.

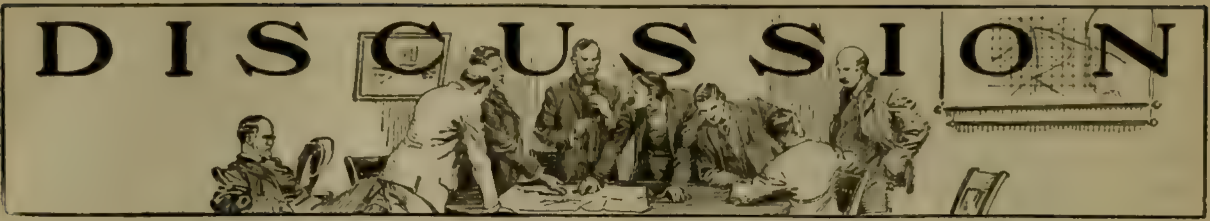
Wasting Coal

A technical paper should aim to interest its readers, as well as to provide matter that is indicative of how additional profit or credit may accrue to the individual, to the corporation, and to the industry. It happens at times that certain sections of the engineering public are addressed more particularly than are others, and this is especially true in regard to generalizations on economy and efficiency. Of the profession as a whole it can be said that only a small proportion of its members are specialists in any branch of mining and metallurgy; only comparatively few rank as experts of a class to be retained by influential corporations for important consultative work. To these, some of the matter that appears in current technical literature may seem to be of a platitudinous character. We recall the indignation displayed when a well-known engineer read in the 'Mining and Scientific Press' that there was a tendency nowadays to use steel and concrete in the construction of new mill-buildings; he protested that the idea was not new, citing an instance in which it had been adopted many years ago. All this was true, but he neglected to realize that only a few engineers were cognizant of the details. The great majority of operators want to know about the use of steel and concrete in mill-buildings. The specialist should see that were we to publish only what is news to him in his own particular field we would cease to cater to over 90% of our subscribers.

A large number of mines, mills, and smelters throughout the world depend for their continuous operation on power generated by the burning of coal; an economical utilization of its latent heat-units is the aim of every power-plant superintendent who has been taught the importance of scientific control by the frequent examination of the waste products. There are, however, scores of users of coal-fired boilers who fail to appreciate the importance of accurate testing; many of these gauge the performance of a boiler by the appearance of the gases coming from the stack, being unaware of the fact that an avoidable waste of coal may be occurring whether the flue-gases be transparent or opaque with particles of unconsumed carbon. The loss of fuel may be traceable to unburned coal in the ash and to an improper proportion of certain gases in the stack. The former loss is easily noticed and readily controlled. The loss in gaseous form is often overlooked; the proportion of carbon monoxide and carbon dioxide present can be determined only by chemical tests. Now that a compact and simple apparatus is available, at a comparatively small cost, there can be no excuse for an unnecessary wastage of gaseous fuel, even in small plants. By using such an equipment, the tests for carbon dioxide are made automatically and at a negligible expense. All that is required is an interest in the problem and an appreciation of a few fundamental facts. It is difficult to estimate the average performance of boilers; but it is probable that, in small plants, less than 60% of the available heat from the coal is utilized for the making of steam. Over 30% of the remainder may be lost in the gases that escape from the stack. This loss may be considered from two viewpoints. Part of it is due to direct loss of heat, in consequence of faulty design, lack of cleanliness, and other less important factors; but usually the greater proportion arises from a neglect to regulate combustion properly. Control of the composition of the escaping gases is only possible when the operation of stoking and the manipulation of draught are guided by quantitative data as to chemical composition, with particular reference to the proportion of carbon dioxide present. The standard recorders are designed to abstract a measured volume of the flue-gases at definite intervals, subjecting it to an absorptive treatment, and recording the result on a chart. The importance of such control is shown by the fact that, in the case of a boiler of an average load of 500 horse-power, burning coal at $4 per ton for 10 hours per day, the saving in fuel per annum by increasing the proportion of carbon dioxide in the flue-gases from 7 to 9% may amount to over $1000. Such control is possible only by the help of proper automatic apparatus, which should be an essential part of all coal-fired boiler equipments.

Parasites

The popular conception of a parasite is an obsequious flatterer who lives at the expense of another; the biological definition according to Webster is "an organism that lives with, on, or in another organism (called its host), from which it gets its nourishment". When we say that the mining industry supports sundry parasites we use the word in the latter sense; that is, we do not imply that the individuals who happen to be involved are toadies or sycophants. They derive their financial nourishment, however, from the mining industry. One of two classes that we have in mind is composed of engineers who are ostensibly participants in the industry but who do more harm than good; on the other hand, those in the second class are not engineers and they admit freely that they are not interested in mines or mining as a source of ore and of metal to be sold. We refer to promoters and stock-salesmen, and in doing so we exclude common swindlers and confine ourselves to those who are reasonably honest. A reasonably honest promoter may be defined as on who is endowed with the imagination and optimism that all promoters possess but who does not mis-state facts deliberately. The relations of such men with the mining industry may be explained by describing the methods that are typical of their activities. A group of promoter-salesmen forms a syndicate for the purpose of taking an option, for which it pays nothing, on a generous block of shares in a company that owns mining property but that has little or no money. The price per share specified in the option, of course, is extremely low. We assume that the property has meritorious features and that a fair-minded engineer would recommend the expenditure of a moderate sum of money for careful exploration or development. The members of the syndicate probaly know nothing about a mine, they may never have been within sight of one, and they do not care whether or not the company has a mine. What they do require is something to talk about to a prospective customer, who may be a doctor or a rancher or a merchant. The approach is generally made by telling about the fortunes that have been made as a result of investment in great mines. If the property under consideration be valuable for its copper, the dividend records of Anaconda, or Utah Copper, or United Verde are paraded for the contemplation of the putative purchaser; if silver or gold be the metal, historical sketches of Tonopah and Virginia City, or Cripple Creek and Goldfield are effective 'openers'. The next step is to correlate the property with the producer, past or present, that is geographically nearest. Nearness to a well-known and successful mine is an exceedingly important feature—the closer the better, of course—but a separation of a dozen miles is a matter of small consequence to an optimist. If the mine happens to be an old one that produced years ago, any question from inquisitive customers as to why mining was discontinued may be answered by glib generalizations regarding modern metallurgic progress and the treatment of complex ores by flotation concentration, which, in the mind of the salesman, may conjure processes and operations that would astound the millman who keeps the froth rising and overflowing. Names of noted engineers and geologists who have examined or who have made even a casual visit to the property are usually fruitful material for selling-talks. Estimated ore-reserves, combining the possible with the proved and probable, make imposing figures; from them is calculated the approximate profit per ton, per day, per year, and per share per annum. But the clinching argument, after the listener has absorbed some of the salesman's enthusiasm, the argument that actually separates the purchaser from his money, is this: "We are going to put this stock on the exchange in all the big cities and are going to send it to $10 per share within 90 days. You can see what a good thing it is and how easily we can do it. You can buy now at $1 per share and be one of the insiders". No matter how valuable the property actually may be, the typical promoter is interested only in the prospect of boosting the price of the stock. These men do not sell shares in a mine; the mine is merely an incidental feature about which they drape a hypnotic story; their business, as they express it, is "to place the paper". They work not on the reason of their customers but on the emotions of those worthy people. The buyer is not convinced that there is a reasonable chance of obtaining dividends from mining operations; he is persuaded that he can sell the shares for more than they cost him. Frequently the stock is listed on the Exchange and the price is boosted; the purchasers of the 'pre-listing' shares may sell at a profit. The mine eventually may prove to be a good one and operations may be successful, though often, of course, some of the purchasers of the shares are left to hold the sack. In any event the promoter-salesmen make a handsome profit. Their stock costs them nothing and at the end of the campaign, which they make short and lively, they have none remaining in their hands. The net result is that the public has contributed a considerable sum of money of which an inconsiderable proportion has found its way into the treasury of the mining company where it is available for the operation of the enterprise. The promoter-salesman of the type we have described appears to qualify as a parasite from the biological point of view; and yet it must be confessed that he is able to raise money, when the owner of a meritorious prospect or mine, or his engineer, would be helpless. Unfortunately the methods of the honest promoter in obtaining money for a legitimate venture are no different from those used by the unscrupulous grafter in selling stock that he knows to be valueless, except that he deals in facts instead of in fabrications. The psychology is the same in both instances. Even when the transaction is a fair one, the toll taken by the promoter is far too high for the service rendered. Why then does the man who has a property with a reasonable chance of success resort to the promoter to finance it? This leads us to the other kind of parasite to which reference has been made, namely, the examining engineer who cannot or will not let his employers or clients take a reasonable chance for fear that the venture may not prove to be a success, and that his individual professional standing will suffer in consequence. There are men in the profession—they call themselves engineers with poor grace—who through some good fortune have established a good reputation. They proceed on the theory of playing, not safe, but ten-times safe. If they condemn a property that afterward proves to be a great mine it is easy to produce an alibi, if indeed the employer has not forgotten about the examination on which it was rejected. Such a man is a mere ore-measurer; even if he is able to appraise intelligently the future possibilities of the mine or prospect, he does not do it. His motive is not to further the best interests of his employer; it is to protect his own selfish interests. The employer expects him to investigate the history, to analyze the geology, and to study the property from other pertinent angles. He expects an estimate of the value of the chance based on sound judgment; he does not expect the engineer to be infallible in his estimates and deductions. We know of men who report unfavorably on every property they examine because they find that to be a safe and sure way of avoiding responsibilty. Such men not only break faith with their employers but they do the mining industry untold harm by making extremely difficult the financing of the development and operation of new or idle properties. They are parasites of the worst kind. The remedy, in so far as these evils can be corrected, lies with the individual and the companies that have the money and that desire to speculate in mining. They can and should detect and destroy the engineer-parasite. It is logical that established mining companies should finance the development of new mines; when they employ more 'engineers' who are engineers, who have the courage to assume responsibility in examining and reporting on properties, the mining industry will be a less receptive 'host' for that other parasite, the promoter-salesman.



To The 'M. & S. P.'

The Editor:

Sir—The announcement, in your issue of March 4, of the sale of the 'Mining and Scientific Press' heralds to many of us the passing of an old friend.

Ever since I can remember, the 'Press' has been a welcome and valued visitor at our office. Through the passing years, and directed by different editors, it has—and noticeably so under the present management—stood for the highest ethics in the mining profession. Blazing the way for truth and clarity of expression, the 'Press' has done much to aid, to educate and encourage the young engineer, and to call forth the best from members of the profession. It has fearlessly condemned and fought the misrepresentation and buncombe of the charlatan and the ignorant.

To my mind there is no more useful or difficult career than that of an editor of a weekly technical paper. The files of the 'Mining and Scientific Press', extending over 60 years, constitute the best history of mining in Western America, and these volumes are a lasting tribute to the industry and ability of the editors.

It has been my fortune to know and count among my friends most of the editorial staff and management of the 'Mining and Scientific Press' for more than 20 years, and personally I feel a debt of gratitude to those who directed the policy of the 'Press'; and this feeling is, I think, shared by many engineers, not only for the excellent paper they produced, but also for their valued friendship and cheerful assistance, freely given.

While the casual subscriber to the combined paper may have some satisfaction in securing the efforts of the combined talent of both papers for one subscription, it is to us, who have followed the career of the 'Mining and Scientific Press' with interest and occasionally marring an issue with a contribution of our own, a distinct loss to realize that the oldest mining paper in the United States, and one so closely identified with Pacific Coast mining, is to lose its identity. The fact that the 'Press' is to be absorbed by a paper so well and so favorably known as the 'Journal' tempers our regret, as also does the fact that you, Mr. Editor, are to continue with the combined papers.

Wishing you continued success, I am

Faithfully yours,

CHARLES JANIN.

San Francisco, March 14.

The Editor:

Sir—The 'Press', arriving today, states that a merger has been arranged between the 'Mining and Scientific Press' and the 'Engineering and Mining Journal'. I am sorry to hear this, as it seems to me that preservation of the individualities of the two leading mining periodicals, one in New York City and one in San Francisco, would be of greater benefit to the mining fraternity. I do not say this in disparagement of the 'Engineering and Mining Journal', as I have great respect for that magazine, and for the editor, Mr. Spurr.

Your editorials have always been timely and fearless, and I am disappointed in the thought that I shall have to forego them after April 1. Wishing you success in the line of work you expect to pursue, I remain,

Sincerely yours,

S. F. SHAW.

Esmeralda, Mexico, March 6.

Research

The Editor:

Sir—I read Dean Probert's article in your issue of January 28 with a great deal of interest. In the main I agree with his very careful presentation. He covered a wide range, and, as he has touched upon several phases that have interested me for a long time, I should like to make a few comments.

The one vital problem now before the entire world is the relation between capital and labor. This relation will reach a culmination before many years, and it will be only through full and free discussion that the trend of public opinion can be guided by those who have given the matter thoughtful consideration. Notwithstanding the wide differences of opinion between capital and labor, it should not be impossible to find some common basis that would be best for all.

It is difficult to entertain the point of view expressed by Judge Gary, that the problem can be solved by governmental regulation. No great problem was ever solved in that way. At best, it would be a makeshift. The Government tried to regulate slavery, but it was a dismal failure after it had been tried for about a century. The Government tried to regulate the liquor traffic, but it was on account of its failure to do so that we now have prohibition. The problem is deeper—much deeper—than governmental regulation.

Again, Mr. Rockefeller's statement that "He believes labor and capital are partners", is, of course, a sophism, however much such a relation might be desired. They have mutual interests, to be sure, but under present conditions they can never be partners. The only way they could be made partners would be through some form of socialism, and I question the advisability of that in our present stage of social, political, and spiritual development. The remark made by Dean Jones of Yale, "By a good citizen, I mean a man who is master of himself, earns his own living, and as far as possible in doing it is of benefit to his fellow man", is of more than passing interest. I would especially call attention to that clause which provides for "earning his own living". There is a world of meaning in that, if broadly interpreted.

I think Dean Probert will agree with me that students who live in fraternity houses costing from $25,000 to $100,000, and who have expensive automobiles that they did not earn, are perhaps not the best candidates for developing the highest type of citizenship. As youths, without any earning capacity, they get accustomed to all the luxuries of successful men that are fairly well advanced in life. Their luxury is likely to cultivate dependence instead of independence. I am somewhat familiar with fraternity life in college and have been in close touch with it for many years; while there is much to be said in favor of it, it has, nevertheless, some objectionable features also.

Andrew D. White, who was the intellectual and spiritual founder of Cornell university, and one of the great college presidents of all time, used to address the incoming class, and the burden of his address was "character". "The object of life is not wealth, not knowledge, not social or political position; but character." This, I take it, is also Dean Probert's view; and yet I cannot help but feel that a university graduate with a high idealism is greatly shocked at the sordidness of the game of life when he first encounters it after graduation. Most of them, however, weather the storm and the readjustment, and ultimately conclude that, after all, character is the one reality most worth-while.

Dean Probert is quite right in saying that "High wages, short shifts, and even good living conditions do not generate industrial peace". The economic problem is deeper—much deeper—than that. It touches the heart of the nation, and for the same reason precisely that life is more than meat and the body more than raiment.

It would be interesting to know how Mr. Sharp would carry out the idea that, "Not scribe but citizen, not author but voter, is the business of the school, the true end of its course of study". A large portion of the people of the United States probably could not give a sufficient reason why they are Republicans or Democrats. Probably the best raeson that many of them could give is because their fathers were of the same political faith. And if some of the members of Congress were asked why they voted in a certain way, the best reason probably they could give is because the leaders of the party so instructed them. Similarly, men are Methodists, Presbyterians, Catholics, etc., because "It is the old-time religion and it is good enough for me". Fortunately, in all ages of the history of the world a large portion of the people—especially those who think—have come to the conclusion that there is nothing good enough for humanity as long as something better can be obtained.

Manifestly the making of good citizens and good voters involves a deep study into the fundamentals of human rights, untrammeled by the injustices of traditions or existing institutions—such a study as was made by the signers of the Declaration of Independence and the framers of the Constitution. If such fundamentals were taught in college, the professor teaching them would probably create a storm that might cost him his job. Again, if only the hackneyed ideas were taught, irrespective of any inquiry into their essential justice or injustice, how could a university develop intelligent voters? It would simply be made a propaganda for party activity. I question seriously whether a professor, say, of political economy, in a university, who taught and advocated the advanced ideas of Jefferson and Lincoln—America's two greatest statesmen—could hold his professorship. To delve into the matter of "human relationship, man to man, nation to nation, and strive for a solution of this world-wide condition of unrest", suggested by Dean Probert, necessarily implies a departure from established conditions, and such a departure necessarily implies a certain amount of radicalism, at least until the new departure becomes established, and then it will become static or orthodox, and remain so until human evolution again outgrows it and another advance has to be made against similar adverse currents. It is impossible to move and stand still at the same time. It is impossible to remedy existing evils while holding to the conditions that produce them.

WILLIAM E. GEENAWALT.

Denver, February 15.

Magnetic Prospecting

The Editor:

Sir—It was with great interest that I read Professor Weeks' article, under the above heading, in your issue of January 21. The theory of the magnetic needle is explained in such a brief, clear, and concise manner that any person interested in this subject must realize the importance and value of magnetic instruments for mining developments. His article, however, lays most stress on the horizontal measurements, whereas the vertical measurements furnish more definite results when tracing weak intensities.

The Professor refers to some "misleading statements" in my article on this same subject, published in your issue of September 24, 1921, which I shall explain and prove correct. I shall also make a few additional explanations regarding the instruments and the methods employed.

(1) My statement:

"The old method of reading the angle of variation, deviation, or deflection in the horizontal plane and the angle of inclination or dip in the vertical plane of the magnetic needle by degrees and fractions thereof, has been discarded, and a compensating or deflecting magnet has been introduced whereby much closer and more accurate readings are obtained."

Comment:

"It would seem that the deflecting magnet of the Thomson-Thalén magnetometer is confused with the yoke-magnet of the Thalén-Tiberg magnetometer. In the Thalén-Tiberg magnetometer, shown in Fig 8, all angles are read in degrees and fractions thereof."

Explanation:

This comment is correct if we only consider what I termed the tangent arm in my article, as shown in Fig. 8. It is true this arm is also used for the sine method; I called it tangent arm merely to distinguish it from Prof. Dahlblom's improved sine arm. The Dahlblom improved sine arm is shown in the second picture of the Thalén-Tiberg magnetometer in my article, but is not shown in Prof. Weeks' article. It is attached to the leveling-head in the same horizontal plane as the combined tangent-sine arm, but with an offset of 30°. In the old method the compensating or deflecting magnet is retained in a definite position on the combined tangent-sine arm and the angle of deflection of the needle is variable and is read in degrees and fractions thereof. In Prof. Dahlblom's method the angle of deflection of the needle is constant and the position of the compensating or deflecting magnet, mounted in the yoke on the Dahlblom improved sine arm, is made variable. The Dahlblom sine arm is graduated and readings are taken direct; the angle of deflection of the needle in this method is not read in degrees and fractions thereof. A scale can be constructed and attached to the Dahlblom sine arm whereby the value of 'R', the resultant of the horizontal component in the earth's normal magnetic field, and the horizontal component of the disturbing element in a disturbed magnetic field, can be read direct.

The Tiberg inclinator for observing vertical measurements is read in angles and fractions thereof, but the Thomson-Thalén magnetometer, a much later invention for observing vertical measurements, is not read in angles and fractions thereof. The readings on this instrument are direct from the micrometer and graduated stem supporting the compensating magnet.

Thus it will be seen that my statement does apply and is correct for both horizontal and vertical measurements.

(2) My statement:

"The horizontal measurements are of minor importance, but the vertical measurements furnish data from which valuable charts are platted . . ."

Comment:

"This has not proved true in this country. The determination of the critical points of horizontal intensity has proved as useful as the determinations of vertical intensities. Moreover, if the horizontal measurements are of no value, why are the instruments constructed? An inclinator would be all that is necessary. It is true that where the attraction of the orebody is very slight the vertical measurements may be of more importance. . . A sweeping statement, however, of the uselessness of horizontal measurements should not be made."

Explanation:

The magnetic intensities exerted by placer deposits—which ordinarily must be classed as comparatively thin blanket formations—and certain vein formations and mineral concentrations containing only a small proportion or entirely devoid of magnetic (attractile) minerals and generally of a limited extent in both area and quantity, are naturally weak compared with the magnetic intensities produced by large magnetite deposits. Precision and accuracy combined with highly sensitive instruments therefore are essential in order to detect these weak intensities and obtain correct results.

Practical experience has demonstrated for this particular work that the vertical measurements are of greater importance and the horizontal measurements of minor importance. By no means do I infer "of no value" or "useless" when I say "of minor importance". Horizontal measurements are important where strong intensities occur.

Complications caused by the presence of two or more veins or mineral concentrations in close proximity to each other are hard enough to analyze and untangle by vertical measurements, but they are practically impossible to analyze by horizontal measurements.

Maps and charts prepared from vertical measurements, obtained when tracing placer deposits, furnish much superior detailed information of the location and extent of the deposit, indicating well-defined areas of maximum, intermediate, and minimum mineral concentrations, which cannot be produced from horizontal measurements.

Theory does not always prove true in actual practice; certain unknown and unexpected elements of nature may interfere, which will cause more or less deviation from anticipated results.

(3) Referring to the title of the first picture, of the Thalén-Tiberg magnetometer, in my article:

This picture is entitled: 'Thalén-Tiberg Magnetometer, Provided with Tangent Arm, for Reading Vertical Intensities'. This sentence contains a typographical error, it should read 'Horizontal' in place of "Vertical".

The term Tangent Arm has been previously explained.

The Tiberg inclinator is shown, in this same picture, set up for measuring vertical intensities, and I admit that the compensating magnet has no bearing on, or connection with, the vertical readings of the inclinator.

(4) Comment:

"Still another instrument, the Thomson-Thalén magnetometer, which is only adapted to the measurement of vertical forces; it does the same work as the inclinator. In this instrument, as in the Tiberg inclinator, the needle is pivoted above the centre of gravity."

Answer:

It is true that the needle in the Tiberg inclinator is pivoted above the centre of gravity; but this is not the fact in the Thomson-Thalén magnetometer, the needles in this instrument, composed of two needles mounted in a ring and supported on two perpendicular steel needle-points resting in agate centres, are pivoted below the centre of gravity—which is one of the principal reasons for the great sensitiveness of this instrument.

(5) Referring to the ordinary dip-needle and the

Dahlblom pocket-magnetometer for reading vertical intensities: Neither of these two instruments is adapted for close and accurate work in localities of weak intensities.

(6) The dial-compass, described and illustrated in Prof. Weeks' article, Fig. 4. This instrument is constructed only for determining horizontal intensities, it may be useful for reconnaissance work where strong magnetic intensities occur and where close and accurate readings take a secondary place, but it cannot be used to any advantage where the intensities are weak.

The main objections to this instrument are:

(*a*) To place the dial-compass true north and south by use of the sun-dial will require a reliable watch for ascertaining the correct time.

(*b*) Apparent sun-time is not identical with true time, a different correction has to be made every day in the year, the observer must therefore be provided with a nautical almanac in order to make the necessary correction.

(*c*) A further correction of time must be made for difference in longitude between the place where local time is derived and the place of observation.

(*d*) Maps or charts can no more be prepared from a survey with the dial-compass than with a magnetometer unless the stations or points of observation are tied in by metes and bounds.

(*e*) "If we know the declination of the compass, we know the direction of magnetic north." Where the disturbed magnetic field covers an extensive area it frequently becomes a hard matter to determine what the exact declination should be for the particular point of observation due to the earth's normal magnetic field.

(*f*) The dial-compass can be used only during clear days, it is out of commission on cloudy days when the sun is obscured.

(*g*) Under the most favorable conditions, the dial-compass does not furnish as accurate readings as the magnetometer, particularly in localities of weak intensities, and where accuracy is of vital importance the observer can accomplish from two to three times as much work with the magnetometer in the same space of time. The dial-compass may save time in localities with great intensities where only approximate readings are required and where the results are not to be mapped.

(7) Comment:

"The magnetometer is not well adapted for use in rough country, because a survey that entails sighting is necessary to locate the stations."

Answer:

This objection must apply as well to the dial-compass, otherwise how can the results of the survey be platted?

(8) Comment:

"Mr. Gibson, I understand, has made surveys of placer deposits with the Thomson-Thalén instrument. If he would discuss in detail his experience in that field, I am sure he would make a valuable addition to the subject."

Answer:

In reply will say that I have been intending for some time to write an article on this subject and will do so in the near future.

(9) Comment:

"From some letters that I have received it seems necessary to point out that the instruments are of value only in detecting minerals that are distinctly magnetic and only when they are present in considerable quantity."

Answer:

I know from my own personal experience that this statement is not true. Further, by referring to Eugene Haanel's book 'On the Location and Examination of Magnetic Ore Deposits by Magnetometric Measurements', published by the Department of the Interior at Ottawa, Canada, in 1904, pages 16-17, Chapter IV, 'The Disturbed Terrestrial Field of Force', it will be seen that there are others besides myself who contend that these instruments will detect and trace non-magnetic minerals under certain conditions.

(10) Prof. Weeks concludes his article with this sentence:

"Manifestly this instrument (referring to the dip-compass or rather dipping-needle) is not sufficiently sensitive to detect 'pay-streaks' unless they are very close to the surface."

Reply:

The definition of 'pay-streak', as applied in placer mining, is a mineral concentration containing free gold or some other valuable metal or mineral in sufficient quantity to more than cover the cost of extraction and recovery. There is no instrument made, be it dipping-needle, inclinator, magnetometer, or dial-compass, that will indicate or detect the presence of gold, and much less whether or not it will be found in paying quantity, no matter how close it may be to the surface. Magnetometric determinations of mineral concentrations or of ore deposits do not disclose anything further than their relative location and extent; actual prospecting and development work is the only method to determine the existing values.

ARTHUR GIBSON.

San Francisco, February 24.

Cyanide Regeneration

The Editor:

Sir—In response to a request from Charles Lintecum in your issue of February 18 for experiences in cyanide regeneration, I trust that the following may be of service.

The operation of a cyanide-regeneration process as it was carried on at the Quartette Mining Co.'s leaching-plant at Searchlight, Nevada, under my management is given here only in a general way, from memory. The details of these operations were described in an article written by R. P. Wheelock, acting chemist on the mine at that time, and published either in the 'Press' or the 'Journal', about 1910.

When a solution became 'foul', it was delivered into a vat that was set some distance away from other tanks and buildings. A quantity of sulphuric acid was delivered into the top of the vat through a gravity pipeline about 100 ft. long. When excessive boiling had ceased, the solution was agitated slightly until all effervescence had ceased, then decanted and passed through a lime bath. This served to fix free cyanide.

We were never able to determine before treatment how much free cyanide would be made available after treatment. The solution was decanted from the treatment-vat on account of a white precipitate, which settled slowly. As this accumulated in the bottom of the vat, it was sluiced into a pond. At first no value was attached to this precipitate.

In an effort to get a better understanding of the regenerating process, an analysis was made of the white precipitate. It was found to contain several hundred dollars per ton in silver, gold, and copper. Several tons of this strange material was shipped to the Selby Smelting & Lead Co, at San Francisco.

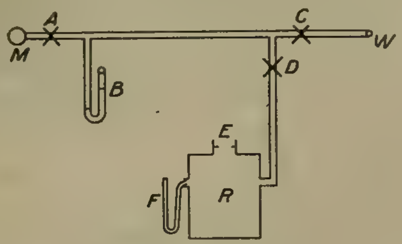
J. E. White.

Santa Barbara, California, March 7.

Measurement of Air

The Editor:

Sir—In your issue of February 25, 1922, Mr. A. S. Fry describes a method for measuring the volume of air drawn into a flotation agitator. The procedure described is with reference to the accompanying sketch.



M = high-pressure air-main
A = valve, to work to be measured
B = mercury-gauge
C = valve to agitator, etc.
D = valve to instrument
R = receptacle with E = diaphragm
F = water-gauge
V = volume of air, cu. in. per min.
d = diameter of orifice, in.
h = water-gauge reading, in.

Operation. Set D closed, C open, regulate A until the air-lift and agitator at W is in normal operation. Read gauge B. Open D and close C. Regulate D until the gauge B reads the same as before, providing that the resistance through the system DRE is equal to that which existed through CW. The diaphragm E is to be chosen with an orifice of such diameter, d, that the reading of gauge F is about 1 or 2 in. = h.

The drop in pressure or resistance through DRE may, by the manipulation of the valve D, be made equal to the drop in pressure through CW, but this does not prove that the flow of air is the same in both cases. A small pipe may offer the same resistance to a small quantity of air as a large pipe would offer to a large flow. The validity of the method depends upon running the same quantity of air per minute through the orifice meter as was passing through the agitator. Adjusting the valve D to hold constant pressure at B is no evidence that the flow has not changed.

The real control of the air is at valve A, which is equivalent to an orifice. If the pressure at B is held constant we may assume a constant flow only if the pressure at M is held constant. If M varies the method is worthless.

Walter S. Weeks.

Berkeley, March 6.

Definition of Engineering

The Editor:

Sir—The revised definition of 'Engineering' by Mr. Parsons, in your issue of March 4, appears to me to omit the highest function of the engineer. This definition appears to limit the activities of the engineer to the solution of engineering problems; but it omits the perception and conception of engineering problems, and the selection of the problem most worth while to solve, as part of the functions of the engineer. The greatest engineers are not those engaged chiefly in "contriving designs, means, and methods and supervising plans". This work is usually done by their assistants. The highest work of the engineer is the conception of new problems and the selection from among these of the key problem. Not much engineering progress would be made without originality of conception and soundness of judgment in selection.

C. V. Corless.

Coniston, Ontario, March 8.

Fluorspar is produced in small quantities at Ishikure, in Ise Province, and also at Hotatsusan, in Noto Province, Japan, states a consular report. The product is of such poor quality, however, that the greater part of the demand is supplied from foreign sources, principally Korea, Manchuria, and South China. So far as can be ascertained, none is imported from the United States. The grade used varies from 50% calcium fluoride, secured from Shinmaku, in Korea, to 80 to 85%, secured from South China. That which grades 80% or more is generally required in the local steel industry, although the Mitsubishi Co. uses a 50% grade at the Kenjiho Works. Fluorspar of 65 to 70% is utilized in the manufacture of glass and enamel-ware. A certain amount is utilized at the Kamioka mine of Mitsui & Co. and also at the Osaka Electric Refinery of the Mitsubishi Co. Approximate prices c.i.f. Japanese ports are as follows: Korean, 50% quality, 12.50 yen per ton; Manchurian and Korean, 65%, 25 yen per ton; South China, 80 to 85%, 50 yen per ton. The total amount of fluorspar used in the Japanese steel industry during 1920 was 230 metric tons, enough underground work has been done to aid an appraisal. Prospects of the first class are judged on their surface showings, and if deposits of similar appearance have been developed in the vicinity the comparison between the two will be valuable. Where no explored deposits exist, it will be much more difficult to estimate the value of the prospect. Especially will this be true if the showing is not favorable. A surface showing such as that over the large Clay orebody at Morenci, if far from a developed orebody, would not attract serious attention. On the other hand, any geologist should recognize the possible value such a prospect as the Copper Mountain at Morenci or the Utah Copper in Bingham canyon must have afforded before mining began there.

The general characteristics of the outcrops of disseminated copper deposits are iron stains and silicification. On closer inspection evidences of the leaching of pyrite may be noted by small iron-stained pits in the rock; also iron oxide in cracks in the rock, and as a superficial wash. The ground has been much fractured and the fractures are cemented by quartz, most of the feldspars and biotite of the original rock having been changed to sericite, kaolin, and iron oxides. Often the little stringers of quartz filling the small fractures will stand out from the softer sericitized rock mass and give the rock a rough or corrugated appearance. Small quantities of copper carbonates, of copper silicates, and of the basic sulphate of copper (brochantite) will probably be found. The carbonate most commonly found is malachite; and in some instances brochantite is probably mistaken for malachite. In arid regions, atacamite is prominent.

The intensity of the iron staining varies from an iron gossan to a light buff coloration. Red, and especially a bright tint of red, is not nearly so favorable as brown and buff tints. Quartzite outcrops are generally darker than the porphyry. Included masses of limestone are likely to be highly colored by iron oxides and copper minerals.

Silicification may have proceeded merely from residual concentration by weathering or it may be of any degree up to the apparently complete replacement of the rock by silica. It may be difficult to distinguish in the field between silicified porphyry and quartzite.

Sericitization may be wide-spread; it may extend over an area far larger than that of the orebodies. In itself neither sericitization nor kaolinization is a reliable indication of ore; usually sericitization is a prominent feature of the outcrop and little if any of the feldspar is unaltered.[9] Kaolin in outcrops is often scarce, as compared with sericite. Chloritic alteration is found in the region surrounding and away from the ore deposits.

The amount of copper mineral found on the surface will vary widely, but it is surprising how little may be found over even an immense orebody. However, I have always been able to find traces of copper somewhere in the outcrop. It is more noticeable in shallow cuts. Adjacent to or within the porphyry areas may be found blocks of limestone, and in these the copper minerals are more prominent than in the porphyry outcrops. The importance of fracturing in forming the ore can hardly be over-emphasized. All outcrops will show evidence of fracturing. The intersection of two or more systems of fracturing or a highly sheeted zone is favorable to ore.

Strong pre-enrichment faults may play an important part in the distribution of the ore. The fault may have a big throw or a small throw, it may be traceable for miles or for a few hundred feet, the main thing is that the ground is fractured extensively parallel to the fault and therefore has afforded an excellent channel for enriching solutions. Faults may be important also in cutting off deposits and in many other ways.[10]

Outcrops of big silicious veins are inconclusive if no developed examples are available in the district. If the ground between the veins is unfavorable in appearance, the veins will probable prove unimportant; but if the ground between the veins is even slightly favorable, the veins may contain enough copper to raise the grade of the material of the enriched zone to the status of 'ore'. In respect of 'ore', it should be borne in mind that the size of a deposit is often a determining factor. A small body of 2% material may not be 'ore' and in the same mine a large body of 1.25% material might be 'ore'. So the size of an area of favorable outcrop is always important. To summarize, the main features of the outcrops of disseminated secondary (supergene) deposits of copper ore, in porphyry, in granite, or in schist, have been found to be:

(1) Surficial iron staining; iron oxide in pits left by the weathering of pyrite and in cracks, giving the area as a whole a buff to brown color, though the rock itself upon breaking will be found almost white.

(2) Induration by concentration of secondary silica and the cementing of small reticulating fractures by silica.

(3) Presence of copper minerals, silicates and carbonates, in varying proportion. A large proportion may constitute an unfavorable indication, as suggesting the possibility of the copper being fixed in a shallow zone incompatible with extensive deposition.

(4) Evidence of much fracturing.

(5) Sericitization of feldspars.

In judging a prospect by the surface showing, the engineer should endeavor to obtain a mental picture of average conditions. It may be necessary to go over the ground repeatedly, arranging and recording the information in his mind and considering each of the factors.

It is impracticable to give examples of all the different outcrops and conditions, but a few of those that have come under my observation may be mentioned.

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[9] In the outcrops of Ely, Nevada, orthoclase remains fairly fresh, see Spencer. In Morenci, Miami, Ray, Bingham, Santa Rita, and other districts this is less common.

[10] For examples of the importance of large faults in disseminated-ore deposits, the Dividend fault at Bisbee and the Yankie and Copper Mountain faults at Morenci and the Miami fault at Miami may be mentioned. See Trans. A. I. M. E., Bull. 117, 1916; U. S. G. S. Prof. Paper No. 43 and 115.

1. An outcrop showed dark buff to brown iron staining, and was granite-porphyry highly silicified with several prominent silicified veins 6 to 36 in. wide. Leaching was shown by pitting and iron oxides; in places where silicification did not obscure it, the sericitization was complete. Sheeting was not marked. Upon development there was disclosed an orebody composed of many veins, the wall-rock between the veins being lean. After the ground began to cave it was seen to be much more highly fractured and sheeted than would have been inferred from the outcrop.

2. The outcrop was a series of bluffs and rugged ground stained light yellowish-red by iron oxides; it showed intense north-east fracturing and lighter north-west fracturing; the rock was a granite or monzonite-porphyry showing development of chlorites and incomplete sericitization. Copper silicates appeared in small specks and pieces. No pyrite was noticed. When prospected thoroughly by churn-drilling the holes sampled from a trace to 1%, with traces predominating.

3. A ridge of monzonite-porphyry showed a good deal of silicification throughout and contained blocks of quartzite. Sericitization was general, but the outlines of feldspar were well defined in many localities. Several large silicified veins of varying strike were noticeable. The iron staining over a small portion of the area was a fairly strong brown, but over most of the area it was a light buff. A good deal of fracturing was noticeable. In one corner of the area there showed a small exposure of carbonates and copper pitch ore in a highly fractured and heavily iron-stained outcrop.

Lessees started to work on the carbonates, and uncovered a good body of ore. Below the carbonates the sulphide ore proved payable, so development was started on the large veins. After thousands of feet of work had been done on these veins the idea of a low-grade orebody was conceived and the system of development was changed correspondingly. A large low-grade orebody (less than 1.50% copper) was developed. Under the light-colored part of the area that by all other indications, except possibly fracturing, was the most unfavorable part of the surface showings, the ore developed was of the grade of the remainder of the body (not including the high-grade corner).

4. At one end of the ground mentioned in example three there was an area similar in respect of fracturing, but it was stained a darker color and more of a red; also it was softer and less silicified, showing more sericite. This ground upon development showed material more spotty in grade and of a lower average than Example 3.

5. An area of granite and monzonite-porphyry stained light to medium brown showed fairly heavy fracturing, much sericite, a moderate amount of silicification and pits due to the leaching of pyrite. A few places showed signs of chloritic alteration. There was a fair showing of copper silicates and a smaller proportion of copper carbonates. When developed by churn-drilling, no ore was found and only a small number of the samples assayed more than a few tenths of 1% in copper.

It is not possible to tell from surface showings alone that there exists a disseminated orebody beneath; and as yet no application of the chemical analysis of surface material has been found to be of much help in solving such questions. The best plan is to judge the showing by careful comparison with that of known orebodies.

Where there is underground work to assist in judging the prospect or where the prospect is judged entirely on underground showings, a new set of conditions is brought into consideration. The leached zones vary in thickness according to such factors as permeability of the ore, the climate, the topography, the length of the period of weathering, the rate of erosion, and the character of the ore and of the gangue.[11] Aridity tends to produce deep leached zones, whereas heavy rainfall and rugged topography tend to produce shallow leached zones. Where the deposits were formed at an ancient water-level and recent erosion has been rapid the thickness of the cap will be less under canyons and arroyas than under ridges. The presence of a considerable amount of pyrrhotite will precipitate the chalcocite at shallow depth. Sphalerite has the same tendency, but much less marked.

The approximate average thickness of cap and ore at several mines are as follows:

	Cap Ft.	Ore Ft.
Nevada Consolidated	103	218
Chino	82	107
Ray Consolidated	250	101
Utah	114	445

The indications of the leached zone, which differentiate it from the comparatively unaltered ground around it, are:

The comparatively unaltered ground enclosing the leached zone will show more pyrite and the rock-forming minerals will be fresher in appearance; there will be a smaller amount of iron oxides, kaolin, and sericite, than in the leached ground. The ore and the leached rock may be alike except for the presence of the sulphides in the ore.[12] Close to the surface or wherever oxidation penetrates along fractures the leached material may show iron oxides. In running a development heading just above an orebody there probably will be found bunches of ore, and if cross-drifts are run and the ore outlines drawn there will be graphically shown a number of ore areas surrounded by waste. The same results would be obtained by a similar procedure below the ore, but the waste areas would generally be more pyritic and thereby indicate the fact of being below the enriched zone. In considering such a problem many other things such as depth below the surface and the relation to known ore-horizons are of value.

In prospecting, the fracturing must be always kept in mind and fractured areas under fair surface showings should be well prospected. Sometimes an orebody will dip away from the prominent fissures, following some obscure fractures that may be cemented and extremely hard to find. The prominent fracturing may belong to a period after the main period of enrichment. Careful mapping and sectioning showing the geology and the ore will yield useful evidence before much damage has been done. Quick changing of theories and development plans to suit facts are often necessary. The geologist should note and study especially all patches of ore cut in unexpected places. This may lead to the finding of large orebodies.

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[11] See 'Enrichment of Ore Deposits', by W. H. Emmons, p. 172.

[12] U. S. G. S. Prof. Paper 115, p. 165.

Supergene enrichment is a cyclic process, and more than one zone of chalcocite enrichment may exist. Also a zone of chalcopyrite enrichment may be found under a zone of chalcocite. Covellite is found sometimes to be prominent at the top of chalcocite deposits.[18] Ore following a fracture-zone may be found under pyritic rock, and oxides or native copper may be found below sulphide ore.

Good ore often occurs along the contact between limestone and porphyry. Blocks of limestone and shale included in copper-bearing porphyry or between two porphyry dikes are likely places for ore, and almost all the porphyry districts have disclosed such deposits. Fracturing is here important also, and certain beds may show a selective mineralization due to causes such as the purity of the limestone or the presence of carbon.

Blocks of quartzite included in the porphyry may contain rich sulphide orebodies. The more permeable the quartzite is rendered by fracturing the better are the chances of finding ore in it.

In the Miami-Ray district there does not seem to be any "marked difference in the susceptibility of metallized schist, granite-porphyry, or diabase to enriching action, except such differences as have just been mentioned as probably due to structure".[14]

It will be seen from the foregoing remarks that prospecting in this class of deposits by mining will consist mainly in searching the zones of fracture at what is thought to be the most favorable elevation. Theoretically, drifts should be run just below the bottom of the enriched zone and the ore developed by raises. However, in practice it cannot be determined in advance of exploration where the bottom of the ore will be, and it is not certain that there will be any ore, therefore it is best to drift across the fractured zones at what is believed to be the elevation most favorable for ore, not taking too many chances of missing the ore in the levels and having to spend extra money in raises that might also prove barren.

In prospecting, if a system of mine levels already exists, the work is done on a level that is believed to be below the ore, in preference to one that may be above the ore, if such a choice is forced. The whole idea is simply to get the most information for the least money; whether or not the locality of the work is to be influenced much by the problem of mining ore depends mainly upon how much reliance can be placed upon the existence of ore where it is to be sought. When it is reasonably certain that a fair orebody exists, it is justifiable to spend extra money to get it by work from the level that will be used for haulage. Once the prospective ore-area is reached it should be cross-cut at right angles to the structure that is believed to be the most important in relation to the ore. This sounds so self-evident as to be almost foolish, but it and the other points above-mentioned I have known to be overlooked.

In prospecting by raising through ore to cap-rock, if the ore has a dip it is best to drive the raises at right angles to the dip of the ore unless that would make the raises too flat for the ore to run. Raises flatter than 55° may be troublesome.

Raises to prospect large low-grade deposits should be spaced at regular intervals, no matter whether they start in ore or waste, so long as they are in the area to be prospected. Such raises should be put up at a distance apart equal to, or a multiple of, the distance apart that the final mining raises will be, and the prospecting cross-cuts should be in like relation to probable mining work. In all planning, the possible relation of the prospecting to later work should be considered; a raise may be shifted to serve for ventilation of a chute; a drift may be run in an indirect route to serve later for haulage, and so forth.

Instead of sinking winzes, underground churn-drilling often may be done and money saved. Prospecting by underground diamond-drilling may also be useful, but in many cases the soft and fractured nature of the rock will be a serious disadvantage.[15]

Prospects under or around old stopes and based on an old-timer's memory are dangerous gambles. My experience indicates that memory is a poor substitute for written records.

PROSPECTING WITH DRILLS. Churn-drilling is the accepted method of prospecting large disseminated deposits. The work at Ajo, Arizona, was done by rotary drilling, and rotary drilling is becoming more common for various classes of work where churn-drilling was formerly supreme.[16] The soft and fractured nature of the ground in most of the disseminated deposits is in favor of churn-drilling.

When it has been decided to drill a piece of ground a good topographic map is made and the area to be drilled is divided into 200-ft. squares; occasionally 100 to 400-ft. squares. Then the construction of a road is started so that holes may be drilled at each corner of the squares.

The holes are drilled through the ore into the waste beneath. In deciding where to stop the drilling in each hole, the geologist considers the assay-record of the hole, the mineralogic record of the hole, and the geologic character of the district.[17] It is best to be sure that the hole is deep enough and has penetrated into the lean primary zone. The record of many holes will be spotty, showing alternate ore and waste, and if stopped in the first 25 or

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[13] Trans. A. I. M. E., Vol. 54, p. 356.

[14] Ransome, F. L., U. S. G. S. Prof. Paper, 115, p. 175.

[15] See 'Data on Miami Churn-Drilling', 'E. & M. J.', Vol. 97, p. 903.

[16] See Trans. A. I M. E., Vol. 51, p. 635, and 'M. & S. P.', Vol. 103, p. 322.

[17] See Trans. A. I. M. E., Vol. 54, p. 93.

even 50 ft. of waste, after passing through ore at a fairly high horizon, it may miss ore below.

Sampling is done by passing the total material brought up by the bailer through a splitter, although A. J. Sale has suggested that bailer grab-samples would be better, taking about a sixteenth. If this is too large a quantity it is reduced by running through the splitter again. Samples are taken to represent each five feet of hole and, after drying in an oven,[18] are sent to the assay-office. The samples should be assayed carefully for total copper, native copper (if suspected), and soluble copper (on composite samples);[19] also for gold and silver if they are present in the deposit. Samples of the pulp, of the panned sample-reject, and of the core (if rotary drilling) are saved and filed carefully for reference. One sampler per each machine-shift will generally be found advisable, and a mineralogist who can also act as head sampler of the shift should look at the panned sample-reject.

Records (which soon become voluminous) are kept of each hole. One large final record-sheet is made for each hole, showing the geological facts and the assay record. These sheets are headed with the number of the hole, the elevation of collar, co-ordinates of collar, date started, and date finished. Columns are made so that for each sample there may be shown the date, depth, size of hole, assays, reliability of sample, cause for bad samples, color of sludge, nature of borings, kind of rock, rock constituents, and minerals—prominent minerals being differentiated from those present but not prominent.

At the right of these columns is one showing the assay-record by averages according to assumed breaks in the grade, and a graph showing the assay-record of the hole made by using the percentage of total copper as the abscissa and the depth of the hole as the ordinate. At the extreme right is shown graphically the size of the hole and the kind of rock penetrated. These large final record-sheets are best filed in loose-leaf holders such as are used for detailed cost-records. From the individual-hole sheets the assay-record of all holes averaged according to assumed grade-breaks are transferred to a tracing (100-ft. vertical scale). This saves much labor in making sections and in looking up assays.

Two sets of sections at right angles to each other are made showing the assays in each hole by averages according to assumed grade-breaks. When the holes are finished they should be capped with a wooden plug and labeled.[20] In later underground work these holes are valuable for ventilation and should not be allowed to become choked by loose rock. The deflection of drill-holes[21] is seldom considered of importance in figuring ore from the drill-records of disseminated copper deposits, but in finding the hole underground a survey of the hole may be necessary. If the deviation is slight, as is usual, a drift may be run to the theoretical location, and the hole found by letting a bell down the hole the proper distance and making a noise. If the hole cannot be discovered by the ear alone, geophones may be used. When using geophones it will probably be necessary to stop drilling for a few minutes in all places near-by and even at considerable distances.

The errors in churn-drill sampling are due usually to (*a*) caving of holes, (*b*) striking veins or faults, (*c*) concentration of heavy rich particles in bottom of holes,[22] (*d*) deviation from vertical. The compensating errors, such as may occur in sampling and assaying, probably balance each other. The probable average error being equal to the probable error in one determination divided by the square root of the number of determinations would make the probable average error in a district insignificant even if 1½% be assumed as the probable error of one determination. The weighing of the dried samples and the figuring of the weight of bailed material per sample against its theoretical weight shows many discrepancies, and does little good except that careless work can sometimes be caught in this way and corrected. The error in churn-drill sampling as shown by mining large deposits is small. I have no definite figures, as dilution and other factors vitiate comparisons. In studying churn-drill records and stope-records, however, it is evident that churn-drill sampling is thoroughly satisfactory for most large low-grade orebodies.

At one property where it was highly desirable to know the reliability of the sampling, I selected nine representative churn-drill holes, and raises put up on these holes were carefully channel-sampled. The ground was monzonite and granite-porphyry. The copper was present mainly as chalcocite disseminated in grains and veinlets. A few veins of 8 to 12-inch width occurred. Eight raises showed the holes to cut a fair section of the ground, and results were that 490 ft. showed 1.44% copper by channeling and 1.38% by churn-drilling. The grade of individual holes ranged from 0.98 to 2.22%. The ninth raise proved that the churn-drill hole had struck a small steep vein, the sample being salted thereby. The average grade of the raise for 90 ft. was 1.38% by channel-sampling and 1.71% by churn-drill sampling.

This example illustrates salting by veins, but to illustrate another phase of the high-assay question I might cite a case where a high-grade hole was really in high-grade ore and was misunderstood. In a low-grade area about thirty holes were drilled and one hole at the extreme edge showed very much better grade than any other in the field, and a second hole near-by showed a spot of good-grade material. On the surface from 150 to 400 ft. from the rich hole and outside of the drilled area was a rock-slide and there was indefinite evidence of a fault headed into the slide. The whole area was iron-stained and showed evidence of leaching and silicification. The men in charge of the work evidently had thought that the high-grade holes were freaks, as they did not drill or otherwise explore the ground further. Several years later MacHenry Mosier and I made an examination of this ground and directed an underground prospect into the district upon the evidence above cited. A considerable body of good-grade ore was developed. It was found that the high-grade hole had passed through one edge of the orebody.

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[18] See 'E. & M. J.', Vol. 101, p. 969, for pictures of splitter and ovens. See also U. S. Bureau of Mines Bull. 107.

[19] May be absent from many deposits.

[20] See also R. H. Poston, suggestion for 'Tagging Diamond-Drill Holes', 'E. & M. J.', Oct. 22, 1921.

[21] For excellent articles on the survey of drill-holes, see Trans. A. I. M. E., Vol. 63, p. 413, Vol. 44, p. 69; and Trans. I. M. M., Bull. No. 91.

[22] See 'Min. & Met. Eng.', February 1921.

In drilling underground with churn-drills or rotary drills one thing must be emphasized: cut out plenty of room for the fast changing of bits. Too little head-room may easily cost more by loss of time than by extra ground removed. Electric operation of churn-drills works nicely underground. In the average porphyry mine, such as that of the Morenci district and on holes not over 250 ft. deep, an average of 10 to 12 ft. can be drilled per 8-hour shift by churn-drills operated underground.

It should be noted that in rotary drilling the assays of sludge and core must be combined by giving each its proper weight. Tables are furnished by the drill manufacturers or contractors to facilitate this operation.

Ira B. Joralemon, in his paper on the Ajo district,[23] gives some data on the checking of rotary-drill sampling. The average grade of the carbonate ore as shown in the reserves was 1.54% and of the sulphides 1.50%. Test-pits were sunk on diamond-drill holes and sampled carefully; 1059 linear feet of test-pits in carbonate ore channel-sampled 0.005% lower than the drill samples, 317 linear feet of combined sinking and raising in sulphide-ore channel sampled 0.05% lower than the drill samples; and 1513 linear feet of drift in sulphide-ore channel sampled 0.26% higher than the average grade of two adjacent holes.

Churn-Drill Field-Models. It is handy in going through the mines to carry a map showing a 100-ft. scale composite of the level workings, the churn-drill holes and topography (50-ft. contours). This map will be handy in the office also, and together with the sections and the holes assay-record by grade-breaks will obviate any need for a churn-drill field-model for preliminary purposes.

Field-models are generally made, however. They are constructed either of wood or metal. A suitable base-plate is drilled and rods inserted to represent the drill-holes. The rods are painted in different colors to represent the grade of material encountered. Proposed work may be outlined in colored thread if desired. Topography may be represented by a wire bonnet such as previously mentioned for mine-models, or, if this is too expensive, contours may be painted on the base-plate. Instead of painting the rods, a strip of paper may be placed around the rods and held in position by a glass tube. The paper can then be colored and lettered to represent the data, and can be removed for making additions by removing the glass tube.[24]

Prospect Maps and Requisitions. In order to keep track of all mine prospects I prefer to keep a set of tracings of the levels on a 100-ft. scale and note the prospects thereon by number, dividing them by legend into 'tentative', 'requisitioned', and 'going'. The tracings may be kept up-to-date and prints given to the mine department. This aids the mine department in getting work done when it is most convenient. Records on cards give details of the prospects. Requisitions for work should always be made in duplicate, and one copy should be kept on file.

Estimating Ore-Reserves. The ore-estimates of an operating company for its own use can usually be classified under one of three heads:

1. Estimates of the developed and probable tonnage and grade of each orebody according to the mining methods decided upon for that orebody, due allowance being made for the error of the sampling and other factors, such as dilution.

2. Estimates made by using an arbitrary standard projection for determining the developed and probable tonnage, the material being estimated by classes between grade-breaks, which are arranged so as to fit in with different possible mining methods as nearly as may be. Any material lower in grade than that thought possible to mine at a profit is classed as waste, and not estimated. Otherwise no attention is paid to the probable mining method, and all blocks of material of the specified grades are estimated even though such blocks may be small, isolated, or otherwise worthless.

3. Estimates of the ultimate yield, for particular orebodies and for the property as a whole.

Estimates of the first class are of particular benefit if the equipment of the property, such as shafts, hoisting arrangements, and mill, are pre-determined and the operating costs capable of close estimation.

Estimates of the second class are of especial benefit as a means of comparison to show the relative amount of material of different grades developed per foot of prospecting in succeeding years and as a sort of preliminary estimate for the planning of mining operations. This kind of estimate, however, is unsatisfactory in many respects; it does not take the place of estimates of the first class as a basis for mining plans, and it may lead to a false conclusion as to the resources of the property. As a measure of the success of prospecting work, it has good points; but for that purpose, statements of footage driven through the different grades of material, with explanatory notes, and especially when accompanied by an estimate of the first class, should be entirely satisfactory.

In estimates of the third class there are more uncertain elements than in the other classes, but they are essential in making the choice of equipment and in evaluating the property.

In estimating by any method the sampling-error should be considered, and, when possible, determined by satisfactory tests. The factors entering into the estimate by reason of the mining method assumed may be: (*a*) inclusion of waste broken with the ore, (*b*) overdraw or inclusion of waste from top and sides of the ore being mined, (*c*) exclusion of certain material of good grade but not minable at a profit, (*d*) exclusion of even small quantities of waste by highly selective mining, (*e*) the relation between the method of mining and the grade of material which can be classed as 'ore', (*f*) in open-cut work the overburden or cap must be computed, whereas in underground work this is not necessary.

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[23] Trans. A. I. M. E., Vol. 49, p. 606.

[24] See 'E. & M. J.', Vol. 97, p. 1015.

The estimating done by a geological department will necessarily be guided, as to the grade of material to be classed as 'ore' and as to the effect of a choice of mining methods, by the information given by the mining department. It is outside the province of this article to discuss the relative features of different methods of mining copper ore, but the geologist should understand thoroughly the different methods in order to answer intelligently the questions of the mining department and to do his own work to advantage.

In non-selective mining, by methods such as block-caving in any of its varieties, the estimation is made from outlines that include everything inside the blocks. The average grade of the blocks is obtained by weighting each sample according to the volume it represents. The amount of material considered as developed will depend upon characteristics of the individual orebody.

In a particular orebody levels 200 ft. apart vertically with drifts and raises 300 ft. apart may constitute a block of developed ore, whereas in smaller and more spotty orebodies work may have to be done 50 ft. or even 25 ft. apart before the ore is regarded as fully proved. The amount of ore classed as 'probable' will vary in like manner. In making projections below or above developed levels with insufficient vertical work to be decisive, the following factors may be considered: geologic habits of the district, position of level in respect to the top and bottom of the enrichment, size of ore area on the level, the evidence of the vertical work.

In determining the position of the level with respect to enrichment, one must consider the evidence offered by the relative amounts of pyrite and of the ore-minerals,[25] and the alteration of the rock. The relative size of the ore-areas and the relative grade of the level in question to that of the other levels is significant. Likewise the intensity of fracturing may enter into the problem. For operating purposes it is wise not to stretch the limits of probable ore, remembering that the operator is likely to lump the developed and probable into one, in spite of all the notes that may accompany the figures. Dilution from various sources in non-selective mining should be kept in mind. In estimates for selective mining the outlines of ore are drawn to exclude most of the waste, including only the small quantities that necessarily are mined and mixed with the ore. No allowance can be made for the running of waste from caving of the ground and like happenings that make tonnage but lower profits. Such things are not supposed to happen.

Estimates of the ultimate yield of a property or of an orebody involve factors that are more speculative than the estimates above-mentioned. For a particular orebody, its various possible extensions are considered; for the property as a whole, there is in addition the prospect of orebodies yet to be found. It is hard to kill a good mine and many properties surpass the expectation of competent engineers. In this class of estimates a knowledge of all the geologic facts pertaining to the ore and of the past yield of the mines is necessary; also a foresight into the future value of low-grade material, or the material of any kind that may in the future be valuable. All estimates should contain a statement of the assumptions made and a definition of any terms that otherwise may be ambiguous.

The chemical analysis of the principal ores and a statement of the mineralogical composition of the ore and gangue will be of especial benefit where the data are to be reviewed by non-resident engineers. The amount of copper present as sulphides, as native copper, and as soluble copper, should be stated for the benefit of the concentrator- and smelter-men. The relative amounts of material of different grades will interest the millman, as he desires to know, for instance, whether the mill will be handling 3% material today and 1½% stuff tomorrow, or whether a constant feed of between 2% and 2½% may be maintained. Statements of such facts, arranged by orebodies, by levels, and by mines, is of great benefit to the mining department in planning a constant mill-feed and in working out haulage problems.

In the mechanical details, care should be taken to keep the work of estimating in such shape that others can follow it through and see what steps were taken. Outlines used in estimates should be recorded permanently on special prints or tracings and filed with the details.

ESTIMATES OF OREBODIES FROM DRILLING records are made in three ways: (1) by outlining the ore-areas on vertical sections and computing from the data on the sections, (2) by dividing the field into squares having a drill-hole in each corner of the square and computing the volume and grade, (3) by dividing the field into triangles having a drill-hole at each apex and computing the volume and grade of the ore.

The method of using the areas measured on sections is preferable where data from both mine-workings and surface-drillings are to be used. The method of triangular prisms[26] is preferable where no mine-workings are to be considered. To use either method the sets of vertical sections at right angles are made to show the grades of the individual holes by grade-breaks. These are assumed from that of the lowest material mined without loss, generally by 0.25% breaks, as less than 0.75%, 0.75% to 1%, 1% to 1.25%, etc. The sections are studied carefully and the ground to be included in the estimate is determined. The depth to consider in figuring each hole being then known, that depth is marked on the assay-record. This contains the assays of each hole averaged between grade-breaks and forms a graphic log of the sampling.

If the method by triangular prisms is employed, the field is divided into numbered triangles in such a way as to give each hole as nearly as possible its proper weight. The data of each hole are tabulated as follows: Number of hole, Class of material, Feet, Foot %.

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[25] Theoretically gold is concentrated in the upper portion of the enriched zone, but owing to the very small proportion generally present this may not be of use in determining the position of the level with reference to the enriched zone.

[26] See U. S. Bureau of Mines Bull. No. 107, p. 18 et seq.

The triangle-sheets are then made and headed: Number of triangle, Number of hole, Area, Average depth, Volume, Average grade. Below are the following subheads: Number of hole, Class, Feet, Foot %, Total feet, Total ft.-%, Average feet for each class,[27] Average ft.-% for each class, Volume of assay for each class.[28] From the triangle-sheets the totals are made up, showing the volume and grade of each class of material, and the grand total and average grade.

If it seems probable that open-cut mining could be profitable, the volume of the cap-rock is figured roughly by multiplying the average depth of the cap by the area of the entire area estimated. If steam-shovel mining is deemed at all feasible, a great many considerations become important.[29] The pit-level is determined, the bottom and side-slope lines are drawn upon the sections, and further estimates are made. The approach work, the total cap-rock to be moved, and the dump-room are figured.[30]

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[27] One-third of total.

[28] By multiplying the average ft.-% by the area.

[29] See 'Steam-Shovel Mining', by R. Marsh; U. S. Bureau of Mines Bull. No. 107; and 'M & S. P.', Vol. 103, p. 624.

[30] For figuring dumps, see Trans. A. I. M. E., Vol. 52, p. 381.

AN ALL-SLIMING CYANIDE PLANT IN AFRICA USING ARTIFICIAL PEBBLES IN THE TUBE-MILLS

Artificial Pebbles For Tube-Milling

By A. W. Allen

Frequent enquiry in regard to the use of artificial pebbles made from country-rock suggests the publication of some notes on the subject. In many cases the increased cost of transportation of beach-pebbles from Europe has prohibited their use. In some instances this has led to a disorganization in the grinding plant and a lowering of efficiency in the metallurgical department, the use of a rock substitute not being considered practicable. In other cases the stoppage of supplies from overseas has been responsible for the adoption of steel grinding media. Such a change is often satisfactory; but there are instances in which the metal balls are obtainable only at considerable expense, where the tube-mills have not been designed to carry the additional load, and where there exists an abundance of suitable stone that could be fashioned to shape for efficient use in the tube-mills.

The utilization of natural pebbles in cylindrical mills was originally a feature of operations in the cement industry. Hard flints, usually gathered on the beaches of Denmark, were used. Later, inferior types of pebbles were substituted, and inefficiency resulted, for no attempt was ever made to standardize on the basis of quality. For this and for other reasons the cement industry adopted an alternative method of grinding; special all-metal mills are now used exclusively for this purpose. Toward the end of the last century the idea of using beach-pebbles of the character described was borrowed for adaptation in connection with the re-grinding of refractory gold ores. Imported pebbles were used almost entirely. Some of these came from Denmark, others from France, the latter being of inferior quality. The only attempt at standardization was according to size and shape, but the Danish flints were always considered the best. They cost more, but they were usually specified because first cost was but a small item of total expense, especially in those instances in which pebbles had to be shipped by boat and railroad, and sometimes by mule, from Denmark to the mine—a distance that, in one instance to my recollection, was 16,000 miles. Under such conditions it was imperative that a high-class material should be purchased in the first instance. Danish pebbles were ordered invariably, but inferior grades were substituted frequently, with disastrous results. At no time was any attempt made by those in charge of ore-dressing plants to determine quality according to toughness and hardness. Flint pebbles were ordered and flint pebbles were supplied. Sometimes they resisted impact to a remarkable degree, but usually they failed to meet the requirements of the simplest test for endurance. Purchasers of such material had no claim against the European shippers or against the local agents. Previous to the War the importation of pebbles assumed large proportions, but no attempt was made at standardization or to determine a method of ascertaining the comparative work done by different shipments or by individual pebbles.

The results of such slipshod buying was that costs for fine grinding were often high, with no remedy at hand. I once superintended the erection of a tube-milling plant in which it was planned to use pebbles that had been shipped nearly 7000 miles. They were supposed to be of the best quality procurable in Europe. The mills were charged with the proper load, and crushing was commenced. An accident occurred after the pulp had been fed from the classifiers for only a few minutes, which forced an immediate shut-down. It was necessary to open one of the tube-mills, whereupon it was found that a large proportion of the flints had chipped and fractured to such an extent that the efficiency of operations, had milling been continued, would have been reduced seriously. The tube-mills, of course, should have been loaded with sand as well as with pebbles in the first instance, but none was available, so the precaution was not taken. However, I found that the fault lay not so much with the local operators as with the character of the pebbles supplied, for later experience showed that an artificial pebble that withstood all impact in a mill empty of pulp could be made at a small fraction of the cost of the imported flint.

The chipping of imported pebbles in a tube-mill results not only in a reduction in size and weight of the grinding media, but it leads to an accumulation of flint gravel that absorbs a considerable amount of power before it can be ground to the average size of the discharged pulp. Such chipping is rarely noticed, but it is an important cause of much of the inefficiency of tube-milling—for the comparatively small return for power expended. This chipping occurs mainly at the feed-end of the mill, which is unfortunate. The pebbles can be added, of course, at the discharge-end, being fed into the mill by means of a reverse spiral; but this necessitates the maintenance of a subnormal charge, which does not permit the egress of small pebbles with the pulp. Further, pebbles of maximum size aggregate at the discharge- rather than at the feed-end of the mill. This is a feature of what is known as the Neal discharge, by which the worn pebbles, which are useless as grinders, are forced back into the interior of the mill until reduced to fine sand or slime.

The numerous disadvantages of using so uncertain a material as the beach-pebble, coupled with the increased cost of freighting as a result of the War, has led to a recognition of the fact that the imported article is by no means ideal for this purpose. Experience with European flints has shown that the importance of one essential characteristic, toughness, has been undervalued; and during recent years an attempt has been made to profit by the work done in other branches of industry in which stone is needed and where it is subjected to repeated impact and continued abrasion. Almost all the scientific work in this connection has been done by civil engineers concerned with the standardization of road-metal, for which toughness and hardness are as essential as they are with tube-milling. Research has shown that it was possible to determine quality on a numerical basis, and to classify the available rock in such a manner that maximum efficiency was secured by the selection of the most suitable material. The work done at Washington by the engineers of the Office of Public Roads and Rural Engineering has covered this subject, although research in the first instance appears to have been started in France in 1878, where a standard of abrasion was formulated that was afterward adopted elsewhere. The work in the United States was commenced on a comprehensive scale in 1900, when a laboratory was established in the Bureau of Chemistry of the Department of Agriculture. In 1905 this was absorbed by the Office of Public Roads and Rural Engineering. The tests made include those for specific gravity and the absorption of water. These do not need explaining. The important tests that serve to quality or to disqualify a rock for tube-milling purposes are as follows:

HARDNESS. In the hardness test a one-inch core of the rock is obtained by means of a diamond-drill; one end is then cut level by a steel disc-saw and a mixture of vaseline and fine diamonds. The test-piece, about 10 centimetres long, is fixed in what is known as the Dorry hardness machine, which is a modified form of a device of French design. This consists of a revolving steel disc against which the test-piece, in a brass grip, is held at an adjusted pressure during 1000 revolutions. Crushed quartz sand is used as an abrasive. The sample is weighed before and after the test, and the loss is noted. What is known as the coefficient of hardness is found by dividing the loss by 3 and by subtracting the result from 20—a figure chosen so as to give much the same range of result as is obtained in the abrasion test, to be described later. Negative coefficients are avoided by dividing the loss in weight by 3.

TOUGHNESS. The test for toughness, I consider, serves to estimate the most essential characteristic of a tube-mill pebble. It is made by obtaining a core as described previously, and then by wearing this smooth on a grinding-lap, using powdered carborundum as an abrasive, until the test-piece is exactly 25 millimetres long. The specimen is then placed in an apparatus known as the Page impact testing machine, in which a hammer weighing two kilogrammes is allowed to fall on a plunger under which the specimen is placed. An electro-magnetic device raises the hammer to a pre-determined distance before each blow. Adjustment is made so that the fall of the hammer is increased one centimetre after each impact. The height of the drop in centimetres when fracture of the test-piece occurs is taken as a measure of the toughness of the stone.

ABRASION. A third test is made to determine resistance to wear. What is known as the Deval abrasion machine is used; this consists of a shaft on which are mounted four cast-iron cylinders (20 by 34 cm. inside dimensions), arranged with the axes at an angle of 30° with the shaft. The sample is broken; 50 pieces of uniform size are selected, which weigh in the aggregate within one gramme of 5000 gm.; these are then placed in one of the mills, which is revolved 10,000 times at 30 r.p.m. After removal, the sample is graded by means of a $\frac{1}{16}$-in. screen, the oversize being then washed, dried, and weighed. The loss is a measure of wear, and is expressed in terms of a percentage of the original weight of the sample. From this percentage what is known as the French coefficient of wear is obtained. I prefer to describe it as the proportionate resistance to wear; for although the

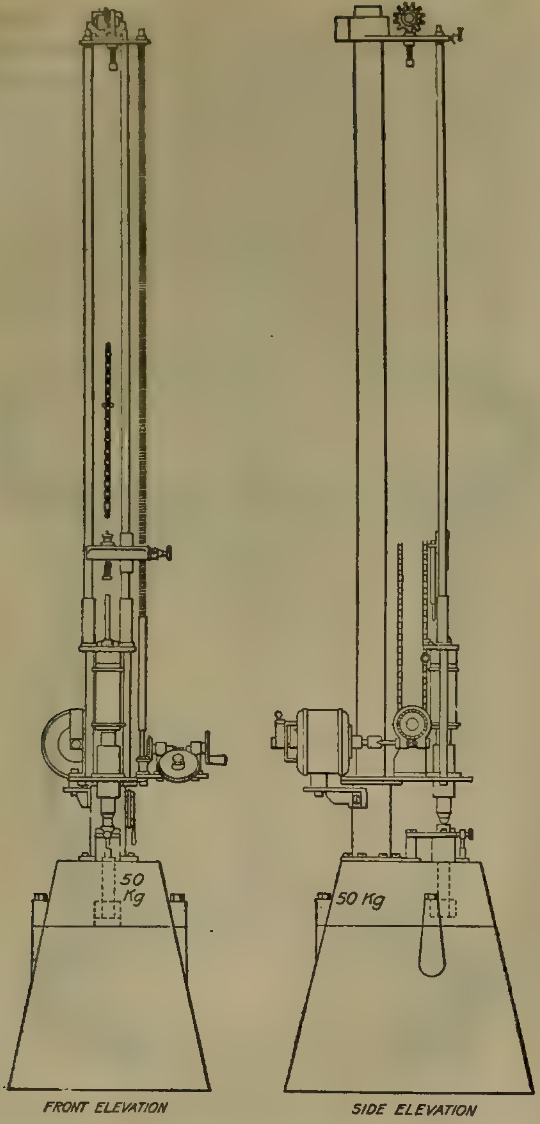


Fig. 1

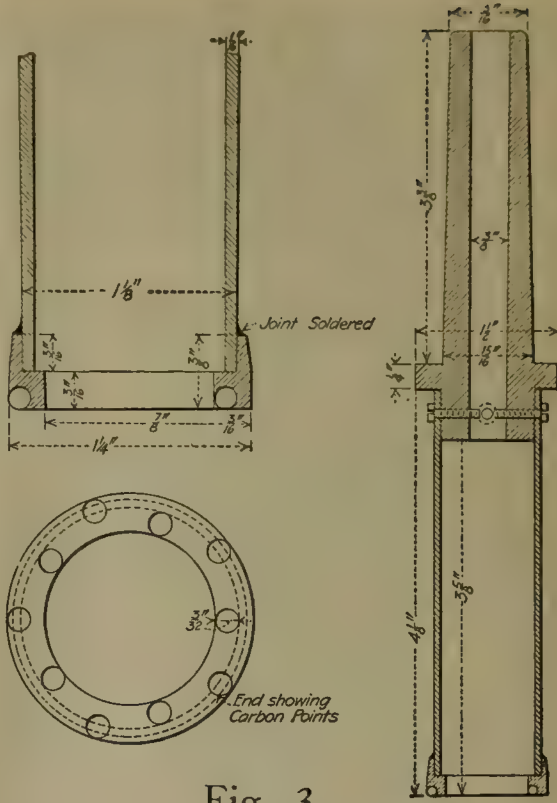
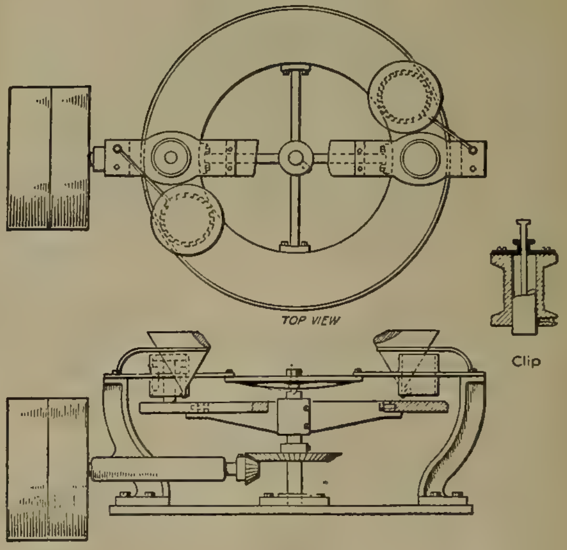


Fig. 3



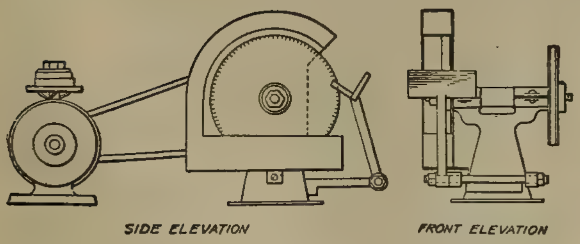


Fig. 2

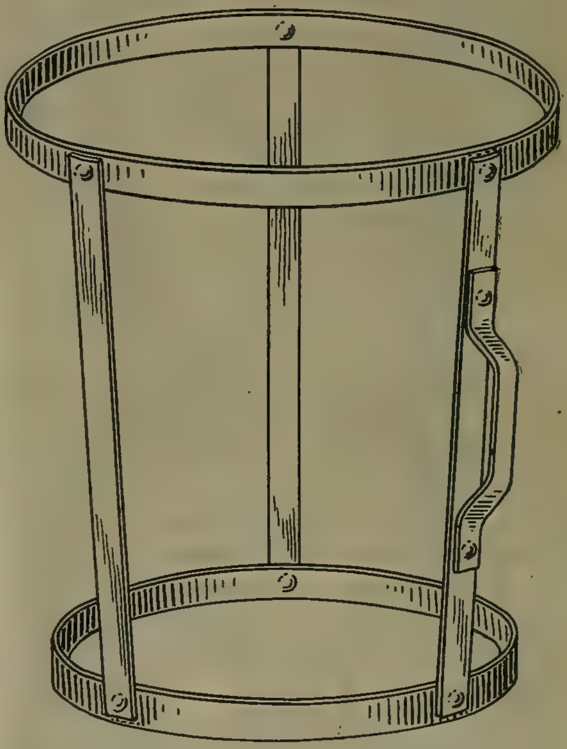
Fig. 4

FIG. 1. PAGE IMPACT TESTING-MACHINE. FIG. 2. DIAMOND-SAW. FIG. 3. DIAMOND-CORE DRILL. FIG. 4. DORRY HARDNESS-MACHINE

coefficients of hardness and toughness increase or decrease in harmony with the hardness and toughness of the specimen, the French coefficient of wear varies inversely as does the loss of weight by fracture and abrasion. The result of this test, however, is not usually of much interest to the ore-dresser, because it merely gives an estimate of the preliminary effect of abrasion in the case of a rough stone. If the rounded pebbles were returned to the mill and the test repeated, informative data would be available.

It is interesting to note that tests made on several thousand types of rock show that hardness is more or less proportionate to toughness, although increasing hardness is not usually accompanied by so great an increase in toughness. In other words, when hardness is at a maximum, as with some types of flint, the toughness may be comparatively low, and this is the cause of fracture. The figures show that a determination for toughness provides data that indicate whether a rock is or is not suitable for tube-milling, whereas a single test for hardness would not suffice, because of the likelihood that hard rock might not withstand impact without fracture. By fixing minimum toughness at, say, 18, as determined by the Page impact machine—by considering only those rocks that if cut to cylinders of one-inch diameter by 25 mm. long would not fracture in consequence of the blow received when a 2-kg. hammer was dropped a height of less than 18 cm.—it is interesting to consider the physical characteristics of various classes of material that will meet this test. In the accompanying table are grouped the data in reference to sundry rocks found in the United States and Canada, all of which have a toughness of 18 or over. These figures have been taken from publications issued from time to time by the Office of Public Roads and Rural Engineering; they serve to indicate the wide variety of material from which a satisfactory pebble can be made. The successful scientific work done at Washington in this connection suggests that the designers of plants might well adopt a similar scheme of testing, to gauge the physical characteristics of ores and in order to determine hardness and toughness before crushing- and grinding-mills are chosen.

Preparation of Rock for Tube-Milling Purposes. Ore is so seldom suitable as a medium for tube-milling that its preparation will not be considered other than in passing. In exceptional cases, as on the Witwatersrand, it has been found applicable, but even in this instance I question whether the grinding efficiency of the tube-mills is as high as it might be, considering the enormous amount of power absorbed during secondary crushing. Country-rock to be used for tube-milling purposes may excel either in hardness or in toughness. In the former case it usually shows a comparatively low toughness coefficient, which indicates a tendency to chip. With the majority of hard rocks, and assuming a preliminary preparation so that a roughly spherical pebble is obtained, this chipping is confined to the removal of jagged corners and projecting pieces. As soon as the surface is smooth the danger of chipping may be small. With such a rock, however, preliminary tumbling in some form of cylindrical mill is desirable, not so much for the purpose of producing a rounded pebble, but to avoid the inclusion of chips of hard rock in the tube-mill, where they are ground and re-ground until discharged. The average toughness of trap-rock, however, is high. With roughly rounded chunks of such material there is little danger of chipping in the mill. They can be fed direct and without preliminary treatment, but the desirability of smoothing can only be determined locally; it depends on whether labor is cheaper than power. When both are inexpensive it is obvious that the manual and mechanical preparation of a pebble that will compare favorably in appearance with an imported flint might be justified.


GAUGE FOR TESTING ARTIFICIAL PEBBLES FOR TUBE-MILLING

The great advantage in the use of artificial pebbles is that they can be produced in some localities for a small fraction of the cost of imported flints. This permits a degree of refinement that is impracticable when the more expensive grinding medium is used. Artificial pebbles can be made of a size to suit exactly the coarseness of the feed going to the tube-mill. The selection of pebbles can be carried out so that maximum efficiency is obtained. A type of gauge shown herewith is useful for testing rock being supplied under contract and according to specification; it consists of two superimposed rings, of flat iron, the test being that the pebble must fall through the larger ring and remain on the smaller one. By keeping the load of pebbles above the centre-line, and by the provision of a screen of punched-metal plate with comparatively large holes (one inch or larger) in the discharge end of the mill it is possible to avoid the crushing to slime or fine sand of a large proportion of the smaller pebbles formed, which are useless as grinding media. In one case, in which power was costly and fixed in quantity, it was found practicable to increase the work done in the tube-mill by over 60% by substituting artificial pebbles of maximum size and by discharging the worn pebbles with the pulp. The net cost of grinding per ton of ore slimed was reduced considerably, with no increase in the cost of pebbles, despite the large proportion of small ones that were discarded.

Rocks of the trap group possess a toughness that makes them especially suitable for tube-milling, for they have none of the brittleness common with flints, chert, and usually quartz. Such material is available in quantity near many tube-milling plants. A test-run may disclose the fact that scope exists for a considerable reduction in the cost of secondary crushing.

Characteristics of Rocks with a Toughness of 18 or Over

State	Material	Wt. per cu. ft., lb.	Resistance to wear, French coefficient	Hardness
Alabama	Quartzite	165	11.7	19.7
	Quartzite schist	164	9.1	18.7
California	Rhyolite	165	23.0	18.7
	Altered basalt	181	27.4	19.2
	Diorite	184	10.8	19.3
	Trachyte rhyolite	153	7.9	18.7
	Altered trachyte	178	23.5	17.8
	Diorite	187	23.8	18.7
	Altered andesite	175	28.6	19.3
	Olivine basalt	175	24.1	18.9
	Basalt	181	19.6	18.2
	Andesite	172	14.2	17.8
Colorado	Augite andesite	175	13.4	18.3
	Feldspar basalt	174	13.8	18.8
	Trachyte	134	12.7	19.1
Connecticut	Diabase	190	12.0	18.3
	Basalt	184	19.4	18.1
	Diabase	187	21.1	18.7
Delaware	Quartzite	187	15.1	18.4
	Pyroxene quartzite	181	18.7	18.5
Georgia	Diabase	190	17.0	18.7
	Feldspathic quartzite	162	7.8	18.5
	Diabase	187	23.5	18.7
Idaho	Basalt	178	19.0	19.0
Illinois	Chert	153	5.6	19.2
Indiana	Limestone	172	4.6	16.2
Kansas	Quartzite	165	18.2	19.3
Maine	Diabase	187	18.7	18.4
	Altered diabase	178	20.0	18.2
	Quartzite	175	15.7	18.5
Maryland	Quartzite	178	20.4	18.9
	Diabase	187	36.4	18.8
	Hornblende schist	181	20.0	18.4
	Diabase	187	20.6	19.2
	Hornblende schist	190	31.7	18.3
Massachusetts	Hornblende granite	168	25.3	18.9
	Altered diabase	187	24.7	17.8
	Dolomite	175	7.4	18.2
	Diabase	193	25.6	18.6
Michigan	Altered diabase	187	18.7	18.7
	Hornblende schist	190	23.5	18.6
	Altered diabase	175	12.7	16.5
	Altered diabase	190	22.0	18.8
	Quartzite	165	20.8	19.5
	Hornblende schist	184	8.5	18.0
Minnesota	Quartzite	165	24.5	19.0
	Epidosite	218	15.4	18.7
Missouri	Chert	125	5.8	19.6
New Jersey	Basalt	184	21.7	17.6
New Mexico	Altered granite porphyry	156	11.8	18.6
New York	Pyroxene quartzite	187	19.4	17.0
	Gabbriotic diabase	181	15.4	18.3
North Carolina	Diorite	184	17.7	18.4
	Diabase	178	15.1	18.0
Oklahoma	Chert	162	14.9	19.2
	Diabase	190	9.7	18.8
Pennsylvania	Pyroxene quartzite	198	21.1	18.3
	Diabase	187	22.5	18.7
	Feldspathic quartzite	165	21.0	18.7
South Dakota	Feldspathic quartzite	168	16.7	19.0
	Olivine diabase	190	14.8	18.7
Tennessee	Dolomite	175	...	18.4
Texas	Silicious limestone	162	11.0	18.2
Utah	Nephilite basalt	190	23.5	18.7
Vermont	Dolomite marble	175	12.3	17.3
	Biotite hornblende schist	181	14.4	18.6
Virginia	Altered diorite	181	14.5	18.8
Washington	Altered andesite	168	18.2	19.2
Wisconsin	Quartzite	168	14.2	19.0
Canada	Altered diabase	187	18.2	18.5
	Altered augite andesite	181	18.7	17.9
	Feldspathic sandstone	168	16.3	18.2
	Amphibolite	187	...	18.3

Wrought Tungsten

Until 1904, tungsten had been known for a century and a quarter in its unrefined state only, although its value as a hardening alloy had been recognized and appreciated, states Irving Langmuir in a contribution to 'Engineering Foundation'. Since 1905, the metal, mixed with paste and squirted through dies, has given the incandescent lamp its most efficient filament; but for years the brittleness of this filament caused great embarrassment to electric-lamp makers and users alike.

For many years W. D. Coolidge, of the research laboratory of the General Electric Co., had sought a process for making tungsten ductile, a feat regarded by metallurgists as almost impossible.

It was found eventually that the only way to make the metal ductile was to mash the grains out into fibrosity, and thus make it ductile while cold. This was accomplished by first heating the tungsten to a temperature below its annealing point and then mechanically working it with infinite care at a variety of degrees of heat, each less than the one preceding, until it was at room-temperature. A process was developed that, if followed without deviation, stretched the grains and made the metal ductile; but with variation from this process, failure resulted; the tungsten when cold would break at a stroke.

Thus, after years of labor, a triumph of far-reaching consequence in the field of research was recorded. The filament produced had a tensile strength of about 600,000 lb. per square inch for wire 0.001 in. diameter. It was so pliable that it could be wound safely into any form and handled with no thought of breaking.

Wolframite, the most important tungsten ore, is obtained in Korea and in the United States. Extraction is comparatively simple. Metallic tungsten in the form of powder of various densities is obtained, which is formed into ingots by great hydraulic pressure, not by fusion. The melting-point of tungsten is about 3350°C. higher than that of any other metal.

The use of tungsten in filament form has doubled the efficiency of incandescent lamps and provides a white light of far purer quality than any lamp heretofore known. It has provided new targets for X-ray tubes, phonograph needles 50 times as efficient as any that preceded them, better ignition-contacts for automobiles, many other new articles, and improvements of old ones.

Adsorption of Gases During Froth-Flotation

By Reginald S. Dean and R. A. White

In a previous article by one of the present writers* it was pointed out that if a film of gas were adsorbed on sulphide minerals but not on gangue minerals that many of the phenomena of froth-flotation could be explained simply. This adsorbed film, in fact, allowed us to deal with sulphide minerals as weighted bubbles. Data were given to show that sulphide minerals adsorbed appreciable amounts of gases, and the theory was advanced that many addition agents owed their action to the effects produced on this gaseous film.

The assumption of such a film of gas may be rejected and the flotation results still explained on practically the same basis if we assume that the solid-liquid interfacial tensions are such as would cause the oil to spread at a mineral-water interface. The present article records preliminary experiments made to test the validity of this last assumption. The evidence is such that in our opinion flotation phenomena cannot be explained on the basis of surface-tension relations unless a film of gas is present on the ore-minerals.

The relations at a solid-liquid(1)-liquid(2) interface are best considered from the standpoint of the contact-angle. The angle of contact δ, that is, an angle that is formed by the interface between a liquid (1), liquid (2), and a solid is given by the equation†

$$\cos \delta = \frac{\beta_2 - \beta_1}{\alpha_{1-2}}$$

Where β_1 is the interfacial energy between the solid and liquid (1).
β_2 is the interfacial energy between the solid and liquid (2).
α_{1-2} is the interfacial energy between liquids (1) and (2).

From this equation it is clear that if $\beta_2 - \beta_1$ is greater than α_{1-2} the angle of contact will be imaginary, that is, one liquid will spread on the solid surface to the exclusion of the other. Since, however, neither β_1 nor β_2 can be determined, this equation leads us nowhere.

It is possible, however, to measure δ and we may thus determine whether the relations of β_2, β_1, and α_{1-2} are those demanded for flotation. For this purpose a simple experiment will suffice. A piece of pyrite is cleansed free from grease and adsorbed oxygen by boiling with sodium hydroxide and pyrogallol and then thoroughly washed without removing from the water. This gives a clean pyrite-water interface. This interface is then inverted and a drop of pine-oil allowed to rise against it. The pine-oil remains as a perfectly spherical drop. If the surface-tension relations were those required for flotation the oil would spread at the interface.

The same experiment may be performed with calcite, with the same result. If now the pyrite is exposed to the air for a few minutes and the experiment repeated, the oil is found to spread to a thin film. The calcite after exposure to air behaves as before. This indicates that a film of air is adsorbed by pyrite and not by calcite, and that this film of air is necessary for oils to spread on a pyrite-water interface.

In order to follow the interfacial relations of minerals further, some contact-angles between water and minerals were determined. The method used was the simple one of measuring microscopically the thickness of large drops on mineral surfaces. The connection between the thickness of the drop and the angle of contact is given by‡

$$\gamma = \alpha \sqrt{2} \sin \left(\tfrac{1}{2} \delta\right)$$

Where γ is the thickness
α the capillary constant
δ the contact-angle
For water $\alpha = 3.87$ mm.

The results obtained follow:

Condition of surface:	γ mm.	Sin $(\frac{1}{2}\delta)$	$\delta°$
Pyrite			
As found	0.551	0.101	11
“ “	0.650	0.117	13
“ “	0.494	0.090	10
“ “	0.482	0.088	10
“ “	0.482	0.088	10
“ “	0.598	0.092	13
“ “	0.545	0.100	11
Cleaned with NaOH and pyrogallol	0	0	0
After 1 min. exposure	0.085	0.015	2
“ 2 “ “	0.390	0.071	8
“ 5 “ “	0.468	0.085	10
Argentite			
Cleaned with NaOH and pyrogallol	0	0	0
After 14 min. exposure	0.430	0.078	9
“ 40 “ “	0.740	0.135	16
Galena			
Cleaned with NaOH and pyrogallol	0	0	0
After 2 min. exposure	0.180	0.033	4
“ 5 “ “	0.740	0.135	16
“ 12 “ “	0.780	0.142	16
Sphalerite			
As found	1.350	0.245	28
“ “	1.120	0.205	24
“ “	1.260	0.230	27
“ “	1.270	0.231	27
“ “	1.350	0.246	28
Cleaned with NaOH and pyrogallol	0	0	0
After 15 min. exposure	0	0	0
“ 25 “ “	0.285	0.055	6
“ 1 week “	1.350	0.245	28

These measurements show that the general idea of sulphides not being wetted by water is based on experience with impure surfaces. With pure surfaces the contact-angle with water is nil, but on standing in air it increases to reasonably constant values. Measurements on calcite and garnet as gangue-minerals showed a similar zero angle after cleansing, and a considerably slower and more erratic recovery.

We hope to make some measurements of the interfacial angles between minerals, water, and some flotation agents; and also to study the effect of various gases and addition agents.

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*‘M. & S. P.’, Feb. 26, 1921.

†Winkelmann, ‘Handbuch der Physik’, p. 1184.

‡Winkelmann. Ibid.

THE QUICKSILVER DISTRICT OF MEADOWS, IN OREGON

Quicksilver in Southern Oregon

By A. E. Kellogg

That quicksilver existed in southern Oregon was only known before the War by a few local operators, by the scientific mining bureaus of Oregon, and by the Geological Survey at Washington. It was during the early days of the War that the Government, in dire need of quicksilver as a war-metal, ransacked this region for new deposits. The investigation demonstrated fully that the quicksilver zone in California extended into Oregon; this discovery disclosed large and rich deposits, which, as shown by State and Federal mining bureau reports, out-class anything that as yet have been uncovered in the United States.

The history of the quicksilver industry in southern Oregon dates to 1878. At that time an early settler in Rogue River valley uncovered croppings in an area known as the Meadows, twelve miles north of Gold Hill—the nearest shipping point. The Meadows is now the centre of the quicksilver area in this region. The settlers have always distilled the quicksilver; they found a ready market for the product among the local miners, who used it for recovering flour-gold in the placers of the region. The crude open-process used in roasting the ores usually resulted in the recovery of about 50% of the metal only, the remainder escaping as vapor and causing mercurial poisoning.

The Gold Hill district is a region occupied chiefly by Paleozoic sediments, interbedded with sills or flows of andesite and greenstone. The sedimentary rocks strike north, usually about N. 15° E. and dip east at 65° to nearly 90°. Dillar has shown that the Jurassic beds west of the Gold Hill district have been overturned so that the oldest strata now overlie the younger formations. It seems probable that the Paleozoic sediments are also overturned; the limestone found in the south part of the district is probably of early Paleozoic times; fossils in the limestone lenses indicate that they are Silurian rather than Carboniferous in age. Accordingly the Paleozoic sediments in the Gold Hill district are referred to as of Devonian or Carboniferous, or as of both periods.

Long after the formation of these Paleozoic sedimentary rocks the region was intruded from below by a mass of molten igneous rock; at about the same time and perhaps by the same agency the bedded rocks were closely folded and overturned to the west. The intrusive rocks solidified beneath a considerable thickness of sediments or other rocks, which have since been removed in some places. Thus, the igneous mass is now exposed to view in the mountains in the southern part of the district, extending northward to the Meadows; and it probably underlies at considerable depth a large part or all of the Gold Hill district.

This igneous intrusion and intense folding seems to have elevated the region sufficiently to cause a new cycle of erosion and the formation of coarse sediments, which could not be transported far by ordinary agencies. Therefore conglomerates were produced, and these were succeeded by feldspathic sandstones during part of Cretaceous times. Rocks produced in this way are now found there. Along Evans creek, from the Meadows northward, these Cretaceous sandstones are overlain by a considerable thickness of Tertiary sandstones that contain thin beds of coal.

The latest rocks in the district consist of stream-deposits, some of which are valuable on account of the gold they contain. They are formed along the streams, but are not abundant along Rogue river, which, in this region, runs in a narrow cut in the rock channel.

The Meadows is at an elevation of 2500 ft., on the south slope of the Umpaqua mountains, in a heavily-timbered and well-watered area. The quicksilver deposit occurs along a granite-sandstone contact, where the granite is in part pegmatitic. It strikes N. 53° W.; most of the mines are less than 100 ft. deep. The mineralized zone is from 100 to 200 ft. wide; it is not a well-defined vein, but is a mineralized dike along an irregular contact. The ore contains cinnabar, native quicksilver, pyrite, gold, silver, zinc, nickel, arsenic, cobalt, and a heavy-black mineral resembling metacinnabarite. Samples assay about $5 gold, 5 oz. silver, 2.5% zinc, traces of the other minerals mentioned, and 1% quicksilver. The cinnabar appears through the ore, in the hanging and foot-walls in seams and in kidneys. The seams vary in width up to 20 in., and average from 17 to 70% quicksilver. The larger bodies of rich ore are found in chimneys and in pay-shoots, which are generally in the faults of the main dike, or appear as veins and stringers.

This description, as to formation and contents, is equally applicable to the dike that extends north from California into and through Jackson, Josephine, and Douglas counties, in Oregon. This dike makes its first appearance in Oregon in the bedrock of the famous '49' placer diggings, four miles north-west of Ashland. Other dikes, which have been considerably faulted, appear as laterals from the main dike—on the west in the Applegate district and extending into Josephine county; on the east into the Butte Creek district. The main vein or dike makes its next appearance north in the Mountain King mine, eight miles north of Gold Hill, then in the Meadows, afterward extending through the Umpaqua mountains into Douglas county, where cinnabar deposits are still in evidence. The Mountain King mine, which has been idle since 1916, is considered the richest and most extensive quicksilver mine in the region.

It was due to the consistent efforts of Samuel Bertleson, at present engineer in charge of the Rainier group of quicksilver mines in the Meadows, that the industry was successfully developed. He went there in 1916, representing Salt Lake City investors and instructed to uncover new war-metal deposits. The company was known as the Utah Quicksilver Co. and it acquired 36 mining claims in the producing area of the Meadows. That same year Bertleson organized the Rainier Quicksilver Co., composed of Puget Sound investors. They took over the Utah group, and in 1917 were producing quicksilver with two 12-pipe furnaces. In 1918, being unable to interest his investors in the possibilities of a more extensive plant, he organized the War Eagle Mining Co., composed of local investors, with headquarters at Medford, Oregon. The company's holdings consist of 520 acres of mining land; up to the present $175,000 has been spent in developing and equipping the property. The adjoining properties, which are heavy producers, are the Chisholm group, owned and operated by Dr. Wm. P. Chisholm, and the Force group, owned and operated by David Force, both of Gold Hill, Oregon. In August 1920 Clifford G. Dennis, a mining engineer of California, examined the mine. The property had produced 565 flasks or 42,375 lb. quicksilver, which was sold for $59,325. This engineer advised the building of a 35-ton Scott furnace, which the company at once erected at a cost of $45,000.

The ore in the War Eagle group is in a true fissure-vein, averaging 5 ft. wide; it comes in contact with the main dike a few hundred feet away. The general geologic conditions existing in this and in the adjoining properties are unlike any others on the Pacific Coast, but they are similar in some respects to those that characterize the deposits at Almaden, Spain. In the War Eagle mine the cinnabar occurs in a breccia and stock-work structure along an open fissure in quartzite. Underlying the quartzite is some bituminous shale of an extent undetermined; there is some evidence of a shaly formation overlying the quartzite. The fissure occurs 60 to 100 ft. south of the north limits of the quartzite area. The width of the quartzite is at least 400 ft. and the length fully 3000 ft. The fissure has a slight dip to the north, again following the indicated dip of the quartzite. A dike-like intrusion of Tertiary or Quaternary age cuts the quartzite east of the ore. It trends north and south, and it is probable that the transportation of the solution from which quicksilver minerals were derived was along this dike. The fissure in the quarzite is a persistent fracture and contains a gouge or salvage, usually on both walls. The cinnabar occurs between fragments of quartzite and by replacement in quartz associated with pyrite. The grade of the ore is in proportion to the amount of quartzite breccia present. Hence the ore is erratic in occurrence.

The mine is opened by two cross-cut adits; the first is about 80 ft. in a south-west direction. A drift about 120 ft. east exposes several pockets of ore. A drift about 110 ft. west shows high-grade ore for 45 ft. The ore-shoot became slightly longer as it was stoped upward, lengthening to about 60 ft. at the surface and 85 ft. above the drift. The average width of ore stoped from this shoot was about 4½ ft. A winze was sunk under this shoot to a depth of 70 ft. and the ore was stoped. The best ore has been taken for reduction in the retorts, and all the faces show a decrease in width and grade. The nature of this deposit indicates erratic occurrence; it is reasonable to suppose that the mine was impoverished of high-grade ore, the work being stopped only when the faces were unpayable, both as to quantity and grade.

The lower adit was driven several hundred feet east of the upper adit, and about 187 ft. lower, to the south-west. It crossed the fissure at approximately 200 ft.; at about 55 ft. east it exposed traces of ore that are likely to develop into small deposits. To the west low-grade cinnabar was exposed for 55 ft., then bunches of ore for 60 ft., of a width varying from 3.3 to 6.2 ft. The ore assayed from 9.1% to 1.75% mercury. Streaks of almost pure cinnabar lead into the north wall. The 42,375 lb. of quicksilver was produced evidently by mining about 1500 tons of ore. The exposures in the upper and lower workings are favorable to a more extensive occurrence of ore; in three places more favorable than where ore has already been extracted. The ore showing at the bottom of the winze in the upper workings is rich. The east drift or upper workings have exposed ore of normal grade. The lower workings contain ore several hundred feet west of the upper workings; exposures on the surface indicate shoots of ore occurring along the fissure for over 900 feet.

PIPE FURNACE IN OREGON

The cost of production per ton recently given by the War Eagle company with present equipment was as follows:

Mining:		
Labor	$2.36	
Supplies	0.60	
Power	0.50	
Tools	0.30	
Foreman and timberman	0.30	
Liability insurance	0.41	
General	0.50	
		$4.97
Development:		
Labor	0.96	
Supplies	0.16	
Power	0.50	
Mucking, track, etc.	0.30	
Tools	0.30	
Liability insurance	0.13	
		2.35
Furnacing:		
Labor	0.72	
Wood	0.20	
Flasks	0.30	
Foreman	0.26	
Power	0.20	
Rock-breaker	0.12	
Liability insurance	0.07	
General	0.05	
		1.92
Management and general		1.20
Total per ton		$10.44

Treating Ashes to Save Unburned Fuel

Washing tests made in the laboratory of the mining department of the University of Illinois show the possibility of recovering the unburned fuel by crushing the refuse to ⅜ in., washing on coal-washing tables, and removing the slime from the washed product by a dewatering conveyor-elevator or a screen, states a U. S. Bureau of Mines bulletin. The coal-washing table is a standard piece of coal-washery equipment, similar to the table used in concentrating plants.

Two washing tests were made, one being with ⅜-in. mesh screenings from the general sample, and the other with the oversize crushed to pass a ¼-in. round-hole screen. Combining the results of these two tests gives the average result from the entire sample of refuse as received from the power-house. The total combined yield of washed fuel was 20% of the gross weight of refuse treated. The washed fuels had an ash content of 25.5% and an average calorific value of 9754 B.t.u. The heating value of the dry screenings ordinarily fired at the plant is about 10,000 to 11,000 B.t.u., and the ash content 18 to 22%. At a great many plants the boiler-furnace refuse contains a larger percentage of recoverable fuel. Operation of a table washery on refuse such as is produced at this plant would result in the production of one ton of fuel from each five tons of refuse handled.

The equipment required for a simple plant of this size consists of a corrugated roll-crusher to which the refuse is fed by a chute direct from the power-plant. The crusher should be set to crush the refuse to about ⅜-in. maximum size. The crushed material is stored temporarily in a feeder-hopper of about five tons capacity, from which it is fed to a washing-table by a short screw-conveyor. Two inclined dewatering drag-conveyors elevate the recovered fuel and also the discard from collecting-sumps to their respective storage-bins.

35-TON SCOTT FURNACE AT THE WAR EAGLE MINE

Better Advertisements

By P. B. McDonald

Seven years ago I was rash enough to send to the editor of the 'Mining and Scientific Press' a manuscript entitled 'Dull Advertisements'. The main argument of it was that many advertisements waste space in unintelligent claims or smart trivialities; they employ such phrases as "gives satisfaction" or "ideal for your needs", which do not impart to the mine-manager, for example, the information that he is seeking about the special advantages of the machine advertised. The editor was courageous enough to print the article (September 4, 1915) and even devoted a main editorial to it. Later, however, I found that several advertising managers objected to being criticized in that way. Their argument was: "Why should the 'Mining and Scientific Press' ridicule its advertisers?" An answer to this can be suggested by analogy: the dramatic critics of the New York newspapers often ridicule a play that deserves ridicule even though there is a big advertisement of the play in the same issue. In other words, free criticism if based on reasonable grounds is justifiable and salutary. My criticism of "dull advertisements" was based on facts.

All this has been recalled by reading in the January 'Smart Set' magazine a criticism of advertisements, written by one of the editors, Nathan or Mencken. Under 'Repetition Generale' this writer says: "In looking through these advertisements in the magazines and newspapers, I am given pause by the considerable amount of idiotic stuff incorporated in them. I frequently wonder if the company officials themselves ever read their own advertisements". The examples that he submits as being untrue or unconvincing include the following:

Victor Talking Machine Co., "Public approval follows artistic leadership" . The editorial comment is that public approval generally does nothing of the sort.

The Pepsodent Dentrifice Co., "Millions of people have accepted this free offer—have made ten-day tests". The editorial comment is to the effect that the "millions" is obviously an absurd exaggeration.

Another criticism made by the 'Smart Set' editor is that the advertisers pick the wrong magazine in which to advertise. For example, publishers of serious books should advertise in a magazine read by thoughtful people, such as 'The Nation'. On the contrary 'The Nation' was found featuring an advertisement of a new greaseless vanishing face-cream.

Applying these criticisms to the advertisements in an engineering periodical like the 'Mining and Scientific Press', it is obvious that the last one, about the unsuitability of the advertised product to the readers, does not hold at all. All the products advertised in the 'M. & S. P.' are used in large quantity by the readers. In fact, many general products, such as clothing, office supplies, building materials, sporting goods, etc., might be fittingly advertised there to a larger extent than at present. The mine manager, sitting in his *sanctum sanctorum* far from the white lights of Denver or Salt Lake City, likes to read about the things that he will buy when next he goes to the city; and he is much more likely to linger over the 'Press' than over a general magazine or newspaper.

But to return to the main criticism of advertisements, namely, that they are uninformative and inaccurate, I do not think that my strictures of seven years ago apply today to the engineering periodicals. At any rate, there has been a considerable improvement, and a better sense of proportion prevails. Even a cursory examination of the advertising pages of the 'M. & S. P.' shows excellent sales arguments and well-chosen information, in spite of an occasional flamboyant word, such as the "gold opinions" ridiculed in the 'Smart Set'. Perhaps the improvement has come through what the business manager of the 'M. & S. P.' calls "co-ordination, co-operation, and conference"; but my own guess would be that it has come, like most improvements, by a better application of common-sense and through intelligent criticism.

Another thought likely to occur to a reader of the 'M. & S. P.' as he turns its attractive pages is that he is much more inclined to linger over its advertisements, because of their reasonable number, than to pause in turning the pages of, say 'The Iron Age', whose hundreds of advertisements fight one another and bore the reader in his effort to find the thin layer of editorial matter. 'The Iron Age' of January 19 has 266 pages of advertisements to 58 pages of editorial matter, a proportion of over four to one. The paper in one copy of that magazine is more than the ordinary novel contains, yet a subscriber gets 52 copies in a year for $6. Its advertisements, though numerous, are strictly technical, being of machinery, tools, pipe, brass rods, belting, hardware, etc. The sales arguments consist of such phrases as: "The highest grade, of all descriptions" applying to steel-plate washers; "Proved by performance" applying to steel buildings (the phraseology lapses into "proven" farther down); "Big savings follow in the route of electric cranes"; "Kill wasted profits" (a peculiar way of putting it) applying to truck-loaders; and "A real gear service backed by experience".

'Industrial Management', a successful monthly periodical, has in its January issue 101 pages of advertisements to 64 of editorial matter. The advertisements include, besides the usual machinery and hardware, such general products as: photostat apparatus for copying letters and documents; vacuum-cleaners; an iodine preparation for wounds; the Alexander Hamilton Institute (a business college taking a full-page advertisement); drinking-fountains; and pencils. The advertisements are phrased in somewhat livelier style than those in 'The Iron Age'. For example: "Bleeding to pay dividends" applying to a bleeder-turbine; "Tempus fugit" applying to time-recording instruments; and "California's developed water-power now exceeds a million horse-power" introducing Stone & Webster, construction engineers. However, even 'Industrial Management', with all its sprightliness, has an occasional brain-fogging sentence in its advertisements. The moral is that in spite of the general excellence there may still be room for improvement.

REVIEW OF MINING

THIRD OF WORLD'S GOLD SUPPLY HELD BY U. S.

When Raymond T. Baker retired as Director of the Mint, on March 20 he turned over to F. E. Scobey, his successor, approximately one-third of the world's gold supply. The gold bullion and gold coin held at the United States mints at Philadelphia, Denver, and San Francisco, and at the assay-office in New York on March 1, totaled more than $3,000,000,000. The world's supply amounts to about $9,000,000,000.

TAXATION AND THE MINING INDUSTRY

The decline of the mining industry, resulting in a nine months shut-down, has served one good purpose, states the 'Anaconda Standard': It has directed the attention of people living in sections remote from mines and smelters to the fact that without mines, Montana's taxation revenues would be far from sufficient to maintain the present rate of governmental expenditures. This paralysis of a great industry suddenly brought people to realize that there are many angles to this question of taxation. An illuminating statement was made by D. M. Kelly at Billings recently when he showed that the Anaconda company lost $10,000,000 last year and paid close to $1,000,000 in taxes. Frankly and comprehensively Mr. Kelly sketched the situation from the standpoint not only of his own company but of the entire mining industry. It is only by open discussion by the presentation of facts and figures and the candid interchange of suggestions, that the people of a State scattered over so large an area and correspondingly unfamiliar with one another's difficulties and problems can arrive at just conclusions in determining how the burden shall be distributed. It is easy to tax an industry out of existence in order to disburse increasingly larger sums of money and ostensibly to extend the operations of governmental agencies, but the matter ultimately resolves itself into the question of how much butter is available to spread over so much bread.

ANGLO-AMERICAN DIAMOND-GOLD COMBINE

Arrangements being made to introduce to the American public the Anglo-American Corporation of South Africa, Ltd.—one of the world's largest producers of diamonds and gold—disclosed the fact that British financiers and New York banking interests control it. The directors are: Sir Ernest Oppenheimer, chairman, Hon. H. Crawford, John W. Finch, W. L. Honnold, W. E. Hudson, Hon. H. C. Hull, F. R. Lynch, Walter McDermott, W. J. O'Brien, and Charles H. Sabin. The New York committee is made up of E. R. Stettinius, chairman, John W. Finch, W. L. Honnold, and C. H. Sabin. Thomas Cochran, Charles F. Ayer, Edgar Rickard, and William C. Potter, respectively, are alternates.

The holdings of the Corporation are chiefly in stock and debentures in the following enterprises: Consolidated Diamond Mines of South-West Africa, Rand Selection Corporation, Brakpan Mines, Spring Mines, West Springs, Daggafontein Mines, and Transvaal Coal Corporation. Notwithstanding unfavorable conditions, it was able to pay two dividends of 5% in 1920 and 5% in the first half of 1921. Earnings permitted of a similar distribution at the end of 1921, but it was considered advisable to conserve cash in view of possibilities arising out of depression in the diamond market and labor troubles which later developed into a strike recently concluded.

ARIZONA

Jerome.—The drift on the 1100-ft. level of the United Verde Extension, toward the Jerome Verde property-line and under the Maintop orebody, is almost at the Jerome Verde and United Verde Extension property line. It is in ore that runs 65% copper, with gold and silver.——The Verde Central shaft is now 40 ft. below the 650-ft. level. The shaft is still in copper-gold-silver ore. The rock is soft and carries chalcopyrite and copper glance. It is the intention of the management to sink to the 1200-ft. level.——It is reported that action is to be taken to secure control of the Shea property by the Calumet & Arizona Mining Company.

Kingman.—The Black Range Mining Co. has succeeded in raising $100,000; diamond-drilling of that property will be commenced at once. Two machines are to be installed. The mine is at Oatman.——The cross-cut on the 500-ft. level of the Gold Trail mine has entered the vein, which at this point is 5 ft. wide and carries gold as high as $22 per ton. This ore is now being drifted on. The property is situated north of Little Meadows; the vein parallels the Gold Road vein. D. A. McMillan is in charge of operations. ——At a point 40 ft. in from the shaft of the Adams mine on the 200-ft. level the cross-cut has broken into the vein and exposed high-grade ore showing free gold. A breakdown in the power-plant has delayed further progress for the present. The Adams mine is in the Katherine district.

Miami.—The shaft being sunk on the Porphyry property by the Inspiration Consolidated Copper Co. is reported as being down 542 ft. This shaft is the largest in the State, being 9 by 18 ft.; it will be carried down to the 1400-ft. level before the first station is cut. The shaft, which will be 1700 ft. deep when completed, will be concreted from top to bottom. A permit for right-of-way for a railroad from the main workings of the Inspiration Consolidated up Webster gulch to the Porphyry shaft has been secured without condemnation proceedings.

Nogales.—Heirs of the Baca Float land grant who held the north half of the property have incorporated the Baca Float Mining & Cattle Co. for $5,000,000 to exploit the mineral and agricultural tracts of the property. It is reported that the corporation has succeeded in selling bonds to the extent of $3,000,000 in New York.

Prescott.—R. S. Patterson of Crown King has taken a bond and lease on four claims belonging to the Del Pasco Mines Co. and Mrs. L. M. Jackson. A pocket of high-grade gold ore was opened during assessment work and has encouraged further development.

Senator Stoddard has purchased the interests of Senator Reynolds in the Copper Mountain mine in the Mayer district. Senator Stoddard announces that he plans to secure immediately finances to carry on extensive development.

Winslow.—It is reported that the U. S. Mining & Smelting Co., which has an option on the Canyon Diablo crater from the Barringer interests has successfully found large masses of meteoric iron at 1000 ft. by drilling under the crater lip. Exploration work to find the supposed buried meteor has been unsuccessful in the past. From the meteor fragments which have been found in the vicinity of the Canyon Diablo crater it is expected that the main mass should run about 92% iron and 8% nickel.

CALIFORNIA

Oroville.—The Surcease mine, 1½ miles from Las Plumas, Butte county, has been sold to prominent operators and bankers of San Francisco. This property has been under development for the last several years by the Goldfield Exploration Co. and Pheby Bros., who own it as a partnership. Recently Joseph Pheby organized a syndicate, headed by James I. Plunkett, which has taken over the property; active work has commenced. J. H. Collier has been appointed superintendent. The present ore-shoot of 500 ft. has been developed for 300 ft. The shaft is to be continued to the 500-ft. level. The vein averages 8 ft. at $9.61 per ton. There are six other parallel veins on the property, which consists of 640 acres. Construction of the mill is expected to start by July 1. The selling price was about $200,000.

Redding.—O. J. Egleston, general manager at Kennett for the U. S. Smelting, Refining & Mining Co., parent corporation of the Mammoth Copper Co., has taken charge of the Balaklala company's property at Coram, four miles away. The rumor persists that a deal for the purchase of the Balaklala by the U. S. Smelting, Refining & Mining Co. is pending.

COLORADO

Platoro.—An important mineral discovery has recently been made about five miles east of Platoro, Conejos county. The district is 38 miles south-west of Monte Vista, the nearest shipping point, and on the divide between the Alamosa and Conejos rivers, ten miles from Walkers ranch and easily reached by automobiles over a good road. The Platoro district on the west shows strong fissure-veins carrying irregular bodies of high-grade gold-silver ores in an andesite formation. Underlying this, and reaching the surface to the east where it comes in contact with a limestone formation, is a diorite in which the new discovery was made near the contact. The mineral comes in a true fissure vein carrying quartz intermixed with considerable limespar. The limestone probably underlies the diorite-porphyry in which this orebody has been found. This discovery was made on the Chelan group, carrying a well-defined fault fissure vein, traceable for nearly a mile in length. It cuts the diorite at an angle of 15° to 25° from the strike of the formation, has well-defined walls standing vertically, and averages 4 ft. wide. The vein carries about 5% iron-copper pyrites with some gold, and silver sulphide—argentite. Four feet of ore has been opened on the surface for 130 ft. and appears to extend to the south fully 400 ft. farther, making a total length of 500 ft. more. The ore averages $24 in gold and silver and carries streaks of copper-iron sulphide near the surface.

MICHIGAN

Houghton.—Several of Calumet & Hecla's conglomerate shafts will be ready for resumption of mining operations on or about April 1. The work of cleaning out the shafts, removing trap or vein rock that has accumulated, re-timbering and straightening the skipways is slow, for only a limited number of men can be employed, and several months will be required to put all shafts in readiness.

In the Red Jacket shaft, where three shifts of men are at work, timbering has been completed to Level 57, and attention is now being paid to the cross-cut extending into the tract below Tamarack Junior. This probably will be the only important section of mining ground available until next fall. In No. 2 shaft extensive repairs will be necessary only for one level, the seventeenth. The greater part of the ground yet to be removed in this shaft consists of pillars, arches, and backs. Although the life of this shaft is limited, an immense amount of rock is still available, and it will be a heavy contributor to production before it is finally abandoned. In No. 4 shaft timbering also is under way. The ground below Tamarack Junior also can be reached from this shaft and in addition there is still a large amount of ground to be mined in the bottom levels. From No. 6 and 7 shafts considerable ore is being removed during the course of re-opening. The Red Jacket shaft and No. 4, 6, and 7 probably will be the shafts to go into commission with the resumption of regular mining. Some minor repairs are being made in the Calumet mill; at the reclamation plant the boiler for the dredge is being overhauled.

Timbermen are still at work in No. 1 Kearsarge shaft of the Osceola, it having been practically re-timbered from the surface. No announcement of a date for the re-opening of the Kearsarge branch of the Osceola has been made; resumption of mining no doubt will depend on labor conditions and improvement in metal demand.

At the Copper Range mines the improvement noted in Trimountain the past six months continues; production from this property is steadily increasing. It has now reached a total of 14,000 tons per month, the ore averaging 30 lb. per ton. At Champion a heavier program of drifting is now in progress and shipments are at the rate of 2500 tons per day. This mine continues to increase its underground force.

The work of putting Gratiot No. 2 shaft, Seneca, in shape for resumption of sinking will proceed rapidly. The concrete shaft collar is almost completed; early in March the operation of the skips and overhauling of the shaft can proceed. The task of straightening out the shaft to conform with the dip of the lode has been completed below the sixth level. Seven more levels are to receive attention. The shaft will be sunk to a depth of 3200 ft., at which point it will be connected with the third-level drift from the Seneca shaft. It is believed it will reach its objective early in 1923. The five drifts, north and south, from the Seneca shaft are proceeding, with an especially good showing in the seventh-level drift, south. This is the bottom level.

The recent reduction in rail freight-rates on refined copper has led to the hope that rates on ore shipments from mine to mill will be reduced. The high cost of transportation, more than double the pre-war rates, is a considerable factor in mining costs, amounting to from one to two cents for mines not owning their own railroads. Mohawk, Wolverine, and Ahmeek are particularly hard hit by these high rates.

Calumet & Hecla is nearing the end of its supply of mineral, mass, and cupola blocks at its smelting plant; April 1 will see this accumulation exhausted, it is believed. Soon after that date, with mining operations in progress, a new supply will be forthcoming. Seven furnaces are in commission at the smelter, and the present net output is in excess of 100,000 lb. daily. Not a great deal of metal is moving out of the district at this time, although small shipments are forwarded occasionally to domestic buyers. The foreign business is almost negligible. Copper Range has a three months' supply of copper on hand at the present rate of production; Quincy, Mohawk, and Wolverine also have good stocks. The C. & H. surplus is still large.

MISSOURI

Carterville.—One of the richest lead strikes in the Carterville district is reported at the Ten O'clock lease, south of that city. Prospectors sunk drill-holes near an old shaft and found the ore at a depth of 70 ft. They then tunneled from the old shaft and for several weeks have averaged 3000 to 5000 lb. lead per week.

Deepwater.—One of the largest coalfields in the State has been discovered near Deepwater, about seven miles south of Clinton, according to Thomas B. Coppage, president of the Kansas City, Clinton & Springfield Railroad Co.

The deposit has been examined by several engineers during the past six months, several drill-holes being put down. The bed was found near the surface and is from 36 to 42 in. deep. It is estimated that the field contains approximately 5000 tons per acre. Samples have been analyzed at the Missouri School of Mines, at Rolla, and found to be a variety of hard coal similar to that mined in south-east Kansas. The samples analyzed were found to be low in sulphur and ash. A company is being formed, operations to begin on July 15.

Joplin.—The Eagle-Pitcher Lead Co. of Joplin has resumed full operation at its smelter, adding 75 men to the force, making a total of about 600 workmen.

MONTANA

Basin.—Active work on the Jib is under way. Geologists of the Anaconda Copper company are studying the formation; two samplers are working under the direction of Walter H. Wiley. Ore is being taken out for experimental purposes, to determine the best method of treatment for the recovery of copper, silver, and gold. In the 600-ft. level the ore carries 2½% copper over a width of 27 feet.

WISCONSIN

Cuba City.—The Zinc Hill and Connecting Link Mining companies are operating steadily and producing in quantity. ——The plant and equipment operated by the Linden Separating Co. was sold under sheriff's sale on March 18. A judgment claim for $1030 against the concern brought the sale.

Highland.—Producers of carbonate zinc ore have at last received offers that are regarded as satisfactory on the better grades of ore, and deals have been closed for March delivery.

Linden.—Outside interests have purchased the Optimo mine and mill, and a new company is being organized to repair the surface equipment and to resume operations.

Livingston.—The Dale mine, operated by the Vinegar Hill Zinc Co., resumed operations early in March after a shut-down of 30 days. The necessity of keeping the acid works of the National Separators supplied with low-grade ore encouraged an early resumption of operations.

Mineral Point.—Pigments have been in good demand for several months past. The Mineral Point Zinc Co. has been shipping regularly; 34 furnaces are in commission.

Shullsburg.—The Pacquette Mining Co. has discontinued production, its bins being filled with ore. The Rodhams Mining Co. continues production. It is called to settle the Rodhams estate on May 4, in which is included the mining rights and holdings in several thousand tons of zinc ore.

BRITISH COLUMBIA

Alice Arm.—An epidemic of influenze has been the cause of suspending practically all mining and prospecting operations hereabouts. Fortunately it was of a mild type.

Rolla.—The oil boom at Pouce Coupe has converted this place, which a year ago had one store and a post-office, into a lively little settlement boasting of a couple of dozen places of business. The Albert Petroleum Co. has a drill on the way here, and expects to start boring by May. A deal involving the transfer of 2500 acres of oil land was consummated at the beginning of this month, and a company is being formed in Quebec, with a capital of $500,000, to operate the property. The previous owners are to receive a royalty of one-eighth of the production, and the agreement calls for the starting of boring operations this summer.

Trail.—During the first week in March, 10,134 tons of ore was received at the smelter, the company supplying 10,032 tons. The other shippers were: Arlington, Slocan City, 8 tons; Ottawa, Slocan City, 21; Paradise, Lake Windermere, 40; and Utica, Adaman, 33.

Usk.—James Brown, in charge of the development of the Regina group, at Ten Mile creek, has uncovered ore ranging from 3 to 8 ft. wide and carrying bands of freibergite from one to two inches wide. A sample of the mineral assayed 320 oz. silver per ton.

Vancouver.—Glenville A. Collins has returned from New York and reports that he has succeeded in making financial arrangements for the re-opening of the Drum Lummon mine, on Hartley bay.

MEXICO

Chihuahua.—Leonides Carrasco, of Madera, has taken up mining claims in the Contreras and Las Tierritas mountains. El Refugio is a group of four adjoining claims that are traversed by a promising vein carrying gold and silver; the Promontorio group of six claims is to be developed for gold, silver, and lead. Other properties have been recently taken up in the Madera district by Rosendo Juarez, of Temosachic. His new denouncement comprises four contiguous claims to be patented under the name of the Guadalupe.——Alberto Madero, of El Paso, Texas, is to develop the Olivo group of silver mines in the Cienegas de Olivo camp near Parral. Preliminary development work is indicating ore carrying silver, lead, and copper. This property adjoins the Lago de Oro mine.——Andres Gonzales, merchant of Juarez, has taken over mining properties in the Magdalena mountains of the Villa Gonzales region. He will develop the Palmar group of nine claims.

Saltillo.—American capitalists are becoming interested in the coal mines of the northern part of this State. The principal mines are near the city of Muzquia. The largest producers are Las Esperanzas, Lampacitos, Palau, El Menor, Clothe, Agujita, and La Rosita. The American Smelting & Refining Co. is working some of the mines near Sabinas. General Gonzales, Governor of the State of Coahuila, is offering special inducement for other American companies to take over mines which are already opened up, as well as exploring that portion of the State for additional coal deposits.

ONTARIO

Cobalt.—The Nipissing during February produced approximately 252,000 oz. of silver valued at $161,282, not including 28,000 lb. of cobalt.——The new 251 vein on the second level shows a 75-ft. length of rich ore, portions of the vein carrying as high as 75,000 oz. per ton across three inches.

Kirkland Lake.—The shareholders of the Ontario Kirkland have ratified the proposed merger with the Montreal-Kirkland and the formation of a new $5,000,000 company. The shareholders of the Montreal-Kirkland voted on the matter on March 15.

Mining activity is extending to the northern part of the district, one of the latest companies in the field being the Providence Gold Mines, the position of which lies east of Goodfish Lake. The development of high-grade ore at the depth of 80 ft. on the Goodfish mine has added to the favorable outlook for this area.

Porcupine.—The re-opening of the Porcupine V. N. T. will take place in April, as sufficient has been secured by the sale of 475,000 treasury shares at 10c. per share, and additional money is available if necessary. As soon as the mine has been unwatered, the shaft will be put down 600 to 900 feet.

The McIntyre is now developing its newly-reached levels between 1500 and 2000 ft., stations having been cut at 1625, 1750, and 1875 ft. These levels will be developed simultaneously and a new haulage-way established at 2000 feet.

South Lorrain.—The Keeley mine during February produced 45,000 oz. of silver. A number of important ore-shoots have been opened recently and the ore-reserves increased substantially.

PERSONAL

H. J. Sheafe is examining mines in Mariposa county.

Charles S. Herzig was recently at Spokane, Washington.

Frank D. Pagliuchi, of Berkeley, has left Cuba and is now in New York.

Sherwood Aldrich, president of the Ray Consolidated Copper Co., is in Europe.

J. O. Greenan is superintendent of the Black Hawk mine, at Randsburg, California.

W. J. Loring is expected in San Francisco on his return from Boston at the end of April.

Earl V. Daveler, mill superintendent of the Butte & Superior Mining Co., is in New York.

J. A. Burgess has returned to San Francisco from an examination of old properties at Austin, Nevada.

Gomper P. Jones has returned to Hedley, British Columbia, from an extended visit in the United States.

E. E. Slack has moved from Cananea, Mexico, and is now with the United Verde Copper Co. at Clarkdale, Arizona.

Joseph P. Schmuck, superintendent of the Consolidated Silver-Lead mine, was at Spokane, Washington, recently.

Ernest W. Dean has resigned from the Bureau of Mines and is now with the Standard Oil Company of New Jersey.

T. Skewes Saunders has been at Batopilas and Chihuahua for several months, and has now returned to Mexico City.

W. T. Rolfe has been appointed superintendent of the Canadia Associated Goldfields mine, at Larder Lake, Canada.

L. I. Shaw has left the ceramic station of the Bureau of Mines at Columbus, Ohio, and is now at the Washington office.

G. A. Joslin, who has been at the main office of the Ramshorn Mines Co., at Salt Lake City, is now at the mine at Bayhorse, Idaho.

A. H. Burroughs, Jr., managing director of the Armstead Mines, has returned to Talache, Idaho, from a short business trip to New York.

Alfred Hunt accepted the position of general superintendent of the Bullion Hill Mining Co.'s property near Sheep Ranch, last December.

W. L. Honnold and **John W. Finch** are directors of the Anglo-American Corporation of South Africa. **Edgar Rickard** and **William C. Potter** are alternates.

Oliver C. Ralston, assistant chief metallurgist of the U. S. Bureau of Mines, will attend the meeting of the American Electrochemical Society at Baltimore, April 27 to 29.

Emmett Hale has been appointed safety inspector at the Original mine, and **William T. Bray** has been appointed safety inspector at the Never Sweat mine, Anaconda Copper company.

H. A. Megraw, formerly on the editorial staff of the 'Engineering & Mining Journal', and more recently with the Van Saun Manufacturing & Engineering Corporation, is now the vice-president and treasurer of the Crown Oil & Wax Co., of Baltimore.

Phil O'Rourke, partner of N. S. Kellogg in the discovery of the Bunker Hill mine on September 10, 1885, died on March 11 at Vancouver. He was born in County Mayo, Ireland, and came to the United States in 1883. In 1885 he and Kellogg were grubstaked by 'Dutch Jake' Goetz and Harry Baer, and so discovered one of the greatest silver-lead mines in the world.

Book Review

The Mining Manual and Mining Year Book, 1922. By Walter R. Skinner. Published by Walter R. Skinner and 'The Financial Times', at 15 Dowgate Hill, Cannon St., London. Price, 21s. 6d.

This book of reference is now so well known that the announcement of another volume is sufficient to incite the customary demand. It gives the particulars concerning mining companies in all parts of the world, but chiefly those registered in London. It gives also lists of mining directors, mining engineers, and mine managers connected with such companies; in short, it is an invaluable compendium for those interested in mining in its world-wide extension.

Recent Publications

The Candelaria Silver District, Nevada. By Adolph Knopf. Bull. 735-A, U. S. Geological Survey, 1922. 22 pp. From Contributions to Economic Geology, 1922—Part I.

Some Characteristics of Run-Off in the Rocky Mountain Region. By Robert Follansbee. Water-Supply Paper 500-C, U. S. Geological Survey, 1922. 17 pp. From Contributions to the Hydrology of the United States, 1921.

Manganese and Manganiferous Ores in 1920. By H. A. C. Jenison. U. S. Geological Survey, 1921. 13 pp. From Mineral Resources of the United States, 1920—Part I.

A Superpower System for the Region Between Boston and Washington. By W. S. Murray and others. Professional Paper 123, U. S. Geological Survey, 1921. 261 pp., 11 plates.

The Microscopic Determination of the Non-Opaque Minerals. By E. S. Larsen. Bull. 679, U. S. Geological Survey, 1921. 294 pp., 1 plate.

The Taylor Creek Tin Deposits, New Mexico. By J. M. Hill. Bull. 725-G, U. S. Geological Survey, 1921. 13 pp.

Ore Deposits of Cedar Mountain, Mineral County, Nevada. By Adolph Knopf. Bull. 725-H, U. S. Geological Survey, 1921. 22 pp.

Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1919. By F. L. Hess. I:26, U. S. Geological Survey, 1921. 19 pp. From Mineral Resources of the United States, 1919—Part I.

California Mineral Production for 1920. By Walter W. Bradley. Bull. 90, California State Mining Bureau, San Francisco, 1921. 218 pp., index, ill., maps.

Gold and Silver in 1919 (General Report). By J. P. Dunlop. I:25, U. S. Geological Survey, 1921. 45 pp., 1 pl. From Mineral Resources of the United States, 1919—Part I.

Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1919 (Mines Report). By C. W. Henderson. I:27, U. S. Geological Survey, 1921. 20 pp. From Mineral Resources of the United States, 1919—Part I.

Secondary Metals in 1920. By J. P. Dunlop. I:10, U. S. Geological Survey, 1921. 15 pp. From Mineral Resources of the United States, 1920—Part I.

Silver, Copper, Lead, and Zinc in the Central States in 1920 (Mines Report). By J. P. Dunlop and F. Begeman. I:11, U. S. Geological Survey, 1921. 43 pp. From Mineral Resources of the United States, 1920—Part I.

Gold, Silver, Copper, and Lead in South Dakota and Wyoming in 1920 (Mines Report). By C. W. Henderson, I:12, U. S. Geological Survey, 1921. 11 pp. From Mineral Resources of the United States, 1920—Part I.

Forty-Second Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior for the Fiscal Year ended June 30, 1921. U. S. Geological Survey. 104 pp., index, ill., map.

Reprint: **Fuel Briquets in 1920.** By W. F. McKenney. II:11, U. S. Geological Survey, 1921. 5 pp. From Mineral Resources of the United States, 1920—Part II.

THE METAL MARKET

METAL PRICES

San Francisco, March 21.

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6—8
Copper, electrolytic, cents per pound	13—13.75
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$90
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.50—7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

March 20.—Copper is active and firm. Lead is quiet and steady. Zinc is light and demand is strong.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Cents	Pence
Mch.	14	63.12½	33.25	Feb.	6	66.35	35.00
"	15	63.62½	33.12½	"	13	65.75	34.22
"	16	64.12½	33.25	"	20	65.44	34.23
"	17	64.37½	33.37½	"	27	64.00	32.92
"	18	64.87½	33.37½	Mch.	6	63.44	32.52
"	19 Sunday			"	13	64.21	33.26
"	20	64.75	33.37½	"	20	64.15	33.29

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	132.77	65.95	65.45	July	92.04	59.99	....
Feb.	131.27	59.55	65.28	Aug.	96.23	61.59	....
Mch.	125.70	56.08	....	Sept.	93.66	66.22	....
Apr.	119.56	59.33	....	Oct.	83.48	71.00	....
May	102.69	59.90	....	Nov.	77.73	68.24	....
June	90.84	58.51	....	Dec.	64.78	65.76	....

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending		
Mch.	14	12.87½	Feb.	6	13.29
"	15	12.87½	"	13	13.17
"	16	12.87½	"	20	12.88
"	17	12.87½	"	27	12.60
"	18	12.87½	Mch.	6	12.58
"	19 Sunday		"	13	12.77
"	20	12.87½	"	20	12.87½

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	19.25	12.94	13.54	July	19.00	12.46	....
Feb.	19.05	12.84	12.95	Aug.	19.00	11.71	....
Mch.	18.49	12.20	....	Sept.	18.75	12.03	....
Apr.	19.23	12.50	....	Oct.	16.53	12.66	....
May	19.05	12.74	....	Nov.	14.63	13.07	....
June	19.00	12.83	....	Dec.	13.18	13.54	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Mch.	14	4.70	Feb.	6	4.70
"	15	4.70	"	13	4.70
"	16	4.70	"	20	4.70
"	17	4.70	"	27	4.70
"	18	4.70	"	6	4.70
"	19 Sunday		"	13	4.70
"	20	4.70	"	20	4.70

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	8.65	4.96	4.70	July	8.63	4.75	....
Feb.	8.88	4.54	4.70	Aug.	9.03	4.40*	....
Mch.	9.22	4.06	....	Sept.	8.08	4.61	....
Apr.	8.78	4.32	....	Oct.	7.28	4.70	....
May	8.55	5.01	....	Nov.	6.37	4.70	....
June	8.43	4.57	....	Dec.	4.76	4.70	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	62.74	35.94	32.04	July	49.29	27.69	....
Feb.	59.87	32.16	30.74	Aug.	47.60	26.35	....
Mch.	61.92	28.87	....	Sept.	44.43	26.70	....
Apr.	62.17	30.36	....	Oct.	40.47	27.70	....
May	54.99	32.50	....	Nov.	36.97	28.93	....
June	48.33	29.39	....	Dec.	34.12	32.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending		
Mch.	14	5.05	Feb.	6	4.85
"	15	5.05	"	13	4.84
"	16	5.07½	"	20	4.85
"	17	5.07½	"	27	4.85
"	18	5.07½	Mch.	6	4.93
"	19 Sunday		"	13	5.00
"	20	5.07½	"	20	5.07

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	9.56	5.86	5.05	July	8.18	4.41	....
Feb.	9.15	5.34	4.85	Aug.	8.31	4.69	....
Mch.	8.93	5.19	....	Sept.	7.84	4.74	....
Apr.	8.76	5.37	....	Oct.	7.50	5.09	....
May	8.07	5.37	....	Nov.	6.78	5.18	....
June	7.92	4.96	....	Dec.	6.03	5.24	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date					
Feb.	21	50.00	Mch.	7	50.00
"	28	50.00	"	14	50.00
			"	21	50.00

Monthly averages

	1920	1921	1922		1920	1921	1922
Jan.	89.00	50.00	50.00	July	88.00	47.75	....
Feb.	81.00	48.75	50.00	Aug.	85.00	47.50	....
Mch.	87.00	45.88	....	Sept.	75.00	47.50	....
Apr.	100.00	46.00	....	Oct.	71.00	46.25	....
May	87.00	50.00	....	Nov.	56.00	40.40	....
June	85.00	49.50	....	Dec.	52.50	49.50	....

COPPER IN LONDON

The London correspondent of the 'Boston News Bureau' reports under date of March 3:

"The copper situation generally does not yet show much life, and confidence is still lacking in regard to the outlook. It is noticeable that the margin between standard and electrolytic tends to diminish, the market for standard having had a better tone during the past week. Indeed it is noticeable that the appreciation in the value of sterling is having a considerably less adverse effect upon standard than was at one time the case.

"In regard to the market for refined metal, however, the outlook is not regarded with bullish feelings, as the continued tendency for the dollar exchange to move in favor of this country naturally means a reduced importing cost for American copper, while the easy tone of the market on your side does not encourage optimism here.

"Business with consuming industries in this country continues to be of small dimensions owing to the fact that manufacturers are finding such a poor outlet for their products. The Continent generally has been doing little, and the feeling is that German demand will not be of such importance during the coming year as it was during the year that has just passed.

"This view is arrived at owing to the feeling that a fair amount of the demand experienced from Germany was for the purpose of re-equipping railways, etc., and that this work has now been completed to a large extent.

"Meantime the continued reports of mines in the United States having decided to resume production naturally removes apprehension of any scarcity of copper when the existing supplies are disposed of, and the fact that sellers on your side are apparently not finding much demand seems to remove the possibility of the stocks being exhausted before the new production appears."

Everyone last December was enthused with optimism; "things were coming right" we were told, and a "spring boom" was at hand. So far, the prophets were wrong and the profits are missing, but there is still time for the improvement predicted. One consolation is that these dips in prices bring metals to an ever more attractive price, and one of these days there will be a genuine stirring of demand, which should be the fore-runner of a gradual expansion all around.

One obstacle is the enormous spread between prices of virgin metals and manufactured goods—a difference largely accounted for by the preposterous labor costs. Hence it is that America has again been taking orders from India for copper sheets, and Germany has been taking Bombay orders for copper squares, which would otherwise have come here.

The fall in copper prices for the week to a certain extent reflects merely the improvement in sterling exchange. There has been some amount of speculation, and the standard market wears an over-sold appearance.

MONEY AND EXCHANGE

Foreign quotations on March 21 are as follows:

Sterling, dollars:	Cable	4.38¾
	Demand	4.38½
Franc, cents:	Cable	9.01
	Demand	8.99
Lira, cents:	Demand	5.11
Mark, cent:		0.35½

Eastern Metal Market

New York, March 15.

Moderate activity characterizes most of the markets; prices are in most cases firm.

Demand for copper has improved; interest is fairly widespread and prices are firm.

Sales of tin have been moderate, but prices have eased.

The lead market continues steady.

Sales of zinc have improved slightly and so have prices.

IRON AND STEEL

An increased demand for steel products is more plainly indicated, but throughout the trade great care is taken lest its extent be overstated. Operations continue at the higher rate shown by February statistics. Buyers and sellers are watching closely for developments in three directions—the coal strike, spring demand, and the effort of the steel companies to advance prices on plates, shapes, and bars.

A strike at union mines on April 1 is expected, and there is more disposition this week to believe that some of the recent buying of steel was precautionary. Non-union mines can increase their output, but some independent steel companies have only union properties.

The gradual broadening of railroad demand is not to be under-estimated as a hopeful feature. Indications are that miscellaneous railroad buying will also be a considerable factor in the near future. The rail-mill at Gary is turning out 35,000 tons per month, and bookings are sufficient to maintain this rate throughout the year.

COPPER

Inquiries and sales are more prominent than for many weeks, and the market has taken on a better tone. Not only are domestic consumers more interested, but sales to foreign melters are the predominant feature and are said to have exceeded the domestic business in quantity and prices. The net profit realized on foreign sales has been higher at the refinery than in the case of domestic business. Prices are almost unchanged at 12.75c., New York or refinery, or 13c., delivered, for electrolytic copper for early delivery; but this level is fast disappearing with 13.12½c., delivered, the minimum almost established. There are those who will not sell below this level. Foreign buyers include European and Far Eastern consumers. Domestic buyers are nearly convinced that the bottom has been reached.

TIN

The market has been quiet during the past week, although some business has been transacted each day in both spot and future. A predominating influence has been the course of sterling exchange, which has shown marked weakness in the last few days, correspondingly affecting the tin market here. There were two days on which fair business was done; on one about 300 to 400 tons changed hands, mostly futures, and on another the turnover was not far less. The decline in the market, which has been expected for some time, came early this week when sterling fell under $4.30 on Monday. Yesterday, however, it recovered somewhat and the price of Straits tin followed closely. Political conditions in England have been the chief cause, but the slump is regarded here as temporary. Quotations yesterday in London were £142 15s. for spot standard, £114 10s. for future standard, and £145 5s. for spot Straits. Spot Straits in New York was quoted yesterday at 29c., or the same as a week ago, recovering from 28.75c. on Monday. Arrivals thus far this month have been 4950 tons, with 4670 tons reported afloat.

LEAD

This market continues with demand equal to production; it is difficult to pick out any feature. It is a healthy market and this trend has characterized it for many months, to such an extent that prices have not changed since last September. The leading interest continues to quote 4.70c., New York, or 4.50c., St. Louis, for early delivery; independents are asking 4.70 to 4.75c., New York, or Eastern points, and 4.40 to 4.75c., New York, or Eastern points, and 4.40c., St. Louis.

ZINC

The firm attitude of producers and a moderate increase in consuming demand continue to be the features of the market, with the result that prices for prime Western have stiffened moderately. Sales are better but not large, but production is on a limited scale also. Quotations for early or 30-day delivery range from 4.65 to 4.70c., St. Louis, and 5 to 5.05c., New York, with the tendency firm. It is difficult to do any business for future delivery, nor is there much desire on the part of consumers to buy ahead.

ANTIMONY

The market is quiet, with prices unchanged at 4.20c., New York, duty paid, for wholesale lots for early delivery. Jobbing lots range from 4.40 to 4.50c.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted in wholesale lots for early delivery at 19c. to 19.10c., f.o.b. plant, by the leading interest, with importers' metal of the same grade from importers at 17 to 18c., duty paid.

ORES

Tungsten: The market is quiet, with only occasional inquiries. Quotations are nominal at $2 per unit and higher, depending on the grade. Scheelite is quoted at $3 per unit.

Molybdenum: Dullness continues and prices are nominal at 45c. per pound of MoS_2 and higher, depending on conditions.

Manganese: There is no interest, consumers being apparently well stocked. Quotations are nominal at 25 to 26c. per unit, seaboard.

Chrome: Quotations are nominal at $18 to $21 per net ton, c.i.f. Atlantic ports; demand is negligible.

FERRO-ALLOYS

Ferro-manganese: Inquiries total 1000 to 1500 tons, and there have been sales of small and 100-ton lots, some of it British. Prices are unchanged on a basis of $62.50, seaboard, for foreign and domestic alloy.

Spiegeleisen.—Demand continues fair, and quotations are unchanged at $30 per ton, furnace, for the lower grade, with the higher quoted at $35 when available. A New Jersey producer will soon blow in a furnace on this alloy, for which it has fairly large orders.

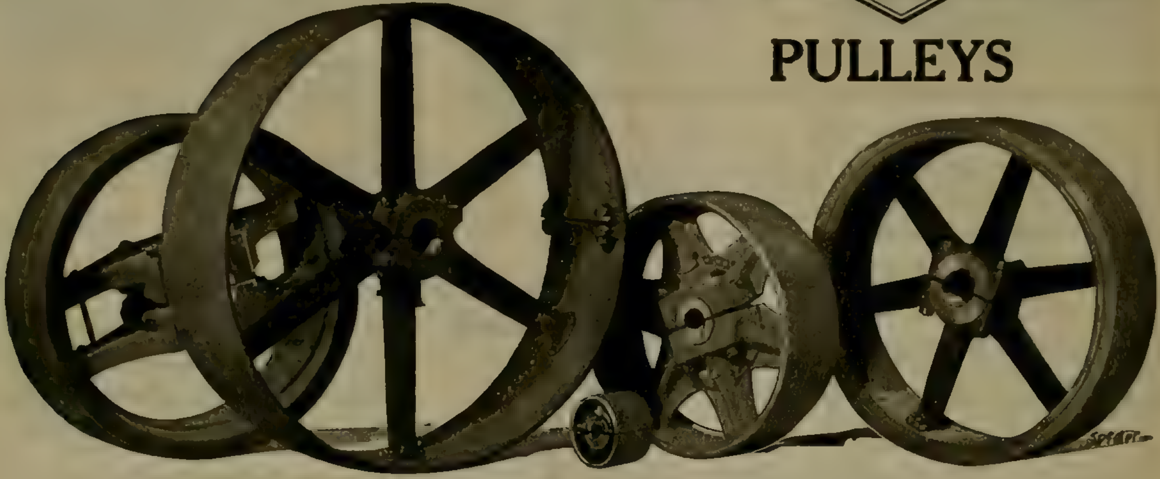
Ferro-tungsten: Inactivity characterizes the market; prices are nominally unchanged at 45 to 50c. per pound of contained tungsten in the domestic alloy.

Ferro-chromium: Prices are nominally unchanged at 12 to 14c. per pound of contained chromium, delivered, in standard alloy.

Ferro-silicon: The 50% market is fairly active and prices are maintained at $55 to $60, delivered, depending on paint and consumption. A sale of 2500 tons is noted at $55, delivered.

The President of Mexico has promulgated a decree, dated January 12, 1922, which is intended to stimulate interest in hydro-electric works. The measure in effect suspends the payment of certain taxes during construction of water-power projects, from the beginning of work until completion; the tax becomes effective when use is made of the water or part of it. The period of suspension is limited to the time for completion expressed in the contract.

DODGE
PULLEYS



Buy *all* kinds of pulleys from Dodge

The first Dodge Wood Split Pulley was offered to the trade over forty years ago. Since that time, over five million have been sold on a guaranteed service basis. Millions of dollars have been saved to power users by their use. Not only is the tractive pull of a leather belt on wood greater than on metal, thereby reducing belt slippage with a resulting power saving, but these pulleys while 40 to 80% lighter than metal will operate safely and successfully at any practicable rim speed and under double belt service.

Dodge Iron Center Wood Rim pulleys are adapted for high speeds and severe service. They will successfully withstand shock loads, reduce belt slippage and run true without vibration.

One million Dodge Standard Split Iron pulleys have been sold since their introduction in 1900. They are adapted for service under severe and unusual conditions and in places where the use of wood pulleys would be impracticable. These pulleys are molded from metal patterns, cast of the highest grade iron, accurately faced on rim and lacquered. These careful methods assure perfect balance and running truth. Split construction obtained by fracturing the rim affords easy installation and when installed and draw bolts tightened the result is a perfect joint.

Dodge-Keystone and Dodge-Oneida Steel Split Pulleys combine lightness with ample strength to withstand the heaviest service. The grooveless oval crown provides a perfect contact surface for the belt, permits operation under low tension, reduces bearing friction, saves power.

National Steel Pulleys in diameters from 3 inches to 5 inches and faces from 3 inches to 5 inches satisfy the demand for a small well balanced pulley suitable for motors, dynamos, machine tools, etc.

You can buy Dodge wood, iron or steel pulleys from Dodge, Oneida and Keystone dealers in your city on an immediate delivery basis.

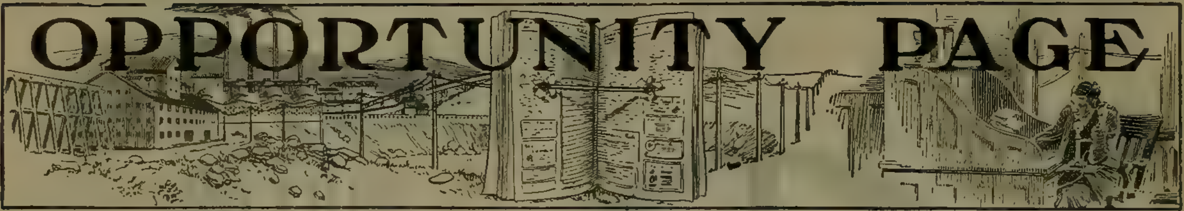
The first order for any quantity will prove the value of Dodge quality and service—a "first order" will undoubtedly lead to complete standardization with Dodge power transmission products. This invariably means low first cost, minimum upkeep and increased continuous production.

Dodge Sales and Engineering Company

General Offices: **Mishawaka, Ind.** ***Works at*** **Mishawaka, Ind., and Oneida, N. Y.**

Philadelphia Cincinnati New York Houston Seattle San Francisco Pittsburgh Atlanta
Minneapolis Chicago Boston Newark St. Louis

OPPORTUNITY PAGE



OPPORTUNITIES

Under this heading announcements may be made of new and second-hand machinery or supplies, for sale or wanted. The cost is 5 cents per word, including address. Minimum charge one dollar per insertion. Remittances must accompany order. Copy must be received by Saturday for the following week's issue.

A THOUSAND DOLLARS REWARD OFFERED; MAYBE TWO OR THREE THOUSAND DOLLARS

I am looking for a mine or an exceptionally good prospect. I want it for myself and some friends who have money to invest in the mining business.

We want something like the Dives-Pelican group of silver mines near Georgetown, Colorado, recently taken over by the East Butte Copper Mining Co.; that is, a similar lay-out proposition and on similar terms. However, we are not particular whether it is a gold, silver-lead, or copper mine. But a mine with an abundance of ore underground and on the dump, readily handled by tables and flotation, would be our first choice.

We mention the Dives-Pelican group because the terms, $500,000.00 purchase price, with a $25,000.00 down payment and an abundance of ore in sight to pay for the property and plenty of time to pay, suits us particularly.

We have diligently looked for a mine or good prospect with real merit for over 20 years. We have traveled tens of thousands of miles and examined over 200 prospects and "mines" and have turned them all down. We have spent considerable money assisting in the development of promising prospects that turned out poorly with further exploration.

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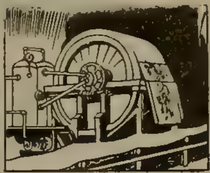
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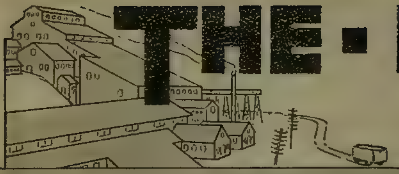

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Morse Bros. Machy. & Supply Co.
National Tank & Pipe Co
Oliver Continuous Filter Co.
Pacific Tank & Pipe Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Dewaterers
Colorado Iron Works
Dorr Co.
General Engineering Co.
Morse Bros. Machy. & Supply Co.
Oliver Continuous Filter Co.
Ruggles-Coles Eng. Co.
Traylor Eng. & Mfg. Co.

Drafting Materials
Dixon Crucible Co., Joseph

Dragline Excavators
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.

Dredges and Accessories
Leschen & Sons Rope Co., A.
New York Engineering Co.
Union Construction Co.
Yuba Mfg. Co.

Drill Makers and Sharpeners
Denver Rock Drill Mfg. Co.
General Electric Co
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drills, Air and Steam
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Cochise Machine Co.
Denver Rock Drill Mfg. Co
Hendrie & Bolthoff Mfg. & Sup. Co
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Rix Compressed Air & Drill Co.
Sullivan Machinery Co.

Drills, Core
Chicago Pneumatic Tool Co.
Dobbins Core Drill Co.
Ingersoll-Rand Co.
New York Engineering Co.
Sullivan Machinery Co.

Drills, Diamond
Ingersoll-Rand Co.
Sullivan Machinery Co.

Dryers
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Fuller-Lehigh Co.
Ruggles-Coles Eng. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Dryers, Rotary
Ruggles-Coles Eng. Co.

Dynamite
Du Pont de Nemours & Co.
Hercules Powder Co.

Ejectors
Lunkenheimer Co.

Electrical Supplies
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Electric Tools, Portable
Chicago Pneumatic Tool Co.

Elevators, Bucket
Buchanan Co., Inc., C. G.

Employment Bureau
Business Men's Clearing House

Engine Trimmings
Lunkenheimer Co.

Engineering Specialties
Lunkenheimer Co.

Engineers (Designing and Contracting)
Stearns-Roger Mfg. Co

Engines, Internal Combustion
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Fairbanks, Morse & Co.
Holt Manufacturing Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Worthington Pump & Mach. Corp

Engines, Oil
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Worthington Pump & Mach. Corp

Engines, Steam
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Worthington Pump & Mach. Corp.

Explosives
Du Pont Powder Co.
Hercules Powder Co.

Filters
Colorado Iron Works
Merrill Co.
Morse Bros. Machy. & Supply Co.
Oliver Continuous Filter Co.
United Filters Corp.
Worthington Pump & Mach. Corp.

Filter Bags
Filter Fabrics Co

(Continued on Page 32)

From the Advertiser's Point of View——

Beginning with the issue of April 1, 1922, the 'Mining and Scientific Press' of San Francisco and the 'Engineering and Mining Journal' of New York will be consolidated into one magazine, to be known as the 'Engineering and Mining Journal-Press'.

The advantage to mining men in having one paper that covers the entire metal mining field in an authoritative way is obvious. But to the advertiser whose business it is to reach the metal mining field the consolidation of these two great national journals is of even greater significance, for it has a direct and favorable effect on his business.

In the past, if an advertiser wished to reach the entire field it was necessary for him to use space in both journals. But now he may reach exactly the same field, he may talk to all of the subscribers of the 'Mining and Scientific Press' and the 'Engineering and Mining Journal', through the consolidated paper. His message in the 'Engineering and Mining Journal-Press' will be carried to every corner of the globe where metals are mined, and the cost will be no greater than he previously paid for a message in one of the journals. In other words, the advertising rates heretofore in effect on the 'Engineering and Mining Journal' have been adopted for the 'Journal-Press', although the advertiser reaches the combined circulation of both papers.

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Not just paint—but proper paint.
Not just surface coverage—but *real protection.*
There's no automatic device to tell just when paint gives out and corrosion starts biting its way in. Time tells relentlessly in depreciated values.
DIXON'S Silica-Graphite paint is immune to attack by heat, cold or moisture. It effectively resists acids, gases and alkalies. It is nature's own mixture of flake-silica graphite, mixed with pure linseed oil.
It stays put—and, inside or out, your plant is *effectively* protected by its use.

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Established 1827
Jersey City, N. J., U. S. A.
Pacific Coast Office: 444 Market Street

BOOKLET 141-B
will give you details on the exceptional protective qualities of DIXON'S.
Send For It.

DIXON'S
Silica-Graphite
PAINT

THE • BUYER'S • GUIDE

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Filter Fabrics Co.

Filter Cloth, Metallic
Ludlow-Saylor Wire Co.
Tyler Co., W. S.
United Filters Corp.

Filter Presses
Merrill Co.
Morse Bros. Machy. & Supply Co.
United Filters Corp.

Fire Extinguishers
Bullard, E. D.

First Aid Equipment
Braun Corporation
Braun-Knecht-Heimann-Co.
Bullard, E. D.

Flotation Apparatus
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Engineering Works Co.
Mine & Smelter Supply Co.
National Tank & Pipe Co.
Simpson Co., A. H.

Flow Meters
General Electric Co.

Forges
Denver Fire Clay Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Sullivan Machinery Co.

Frogs and Switches (see 'Railway Supplies')

Forgings
Cambria Steel Co.

Furnaces, Assay (see 'Assayers' and Chemists' Supplies')

Furnaces, Oil
Denver Fire Clay Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Furnaces, Roasting and Smelting
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Denver Engineering Works Co.
Dwight & Lloyd Sintering Co., Inc.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Traylor Eng. & Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Gears
American Steel Foundries
Chicago Pneumatic Tool Co.
Denver Engineering Works Co.
Fawcus Machine Co.
General Electric Co.
Meese & Gottfried Co.

Gears, Herringbone
Fawcus Machine Co.

Generators, Electric
Allis-Chalmers Mfg. Co.
General Electric Co.
Morse Bros. Machy. & Supply Co.
Westinghouse Elec. & Mfg Co.

Giants, Hydraulic (see 'Hydraulic Mining Machinery')

Graphite Products
Bartley Crucible Co., Jonathan
Dixon Crucible Co., Joseph

Grinders, Laboratory
Braun Corporation
Braun-Knecht-Heimann-Co.
Caire Co., Justinian
Calkins Co.
Denver Engineering Works Co.
Ingersoll-Rand Co.

Grinding Machinery
Hardinge Co.

Grinders, Portable, Air and Electric
Chicago Pneumatic Tool Co.

Grinding Wheels
New York Belting & Packing Co.

Hammers, Pneumatic
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Ingersoll-Rand Co.

Heaters, Feed Water
Allis-Chalmers Mfg. Co.
Morse Bros. Machy. & Supply Co.
Worthington Pump & Mach. Corp.

Hoists, Electric
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Denver Engineering Works Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Ottumwa Iron Works
Rix Compressed Air & Drill Co.
Westinghouse Elec. & Mfg. Co.

Hoists, Oil and Distillate
Denver Engineering Works Co.
Leschen & Sons Rope Co., A.

Hoists, Portable Air Turbine
Denver Rock Drill Mfg. Co.
Sullivan Machinery Co.

Hoists, Steam or Air
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Ottumwa Iron Works
Rix Compressed Air & Drill Co.

Hose
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Cochise Machine Co.
Denver Rock Drill Mfg. Co. Co.
Ingersoll-Rand Co.
New York Belting & Packing Co.
Rix Compressed Air & Drill Co.

Hydraulic Mining Machinery
Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
American Spiral Pipe Works
Garratt & Co., W. T.
Ingersoll-Rand Co.
New York Engineering Co.
Pelton Water Wheel Co.
Sacramento Pipe Works

Hydrocyanic Acid, Liquid
American Cyanamid Co.

Industrial Railways, Portable
Koppel Industrial Car & Equip. Co.

Injectors
Lunkenheimer Co.
Morse Bros. Machy. & Supply Co
Powell Co., Wm.

Jigs
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Denver Engineering Works Co.
Morse Bros. Machy. & Supply Co.
New York Engineering Co.
Traylor Eng. & Mfg. Co.
Union Construction Co.
Worthington Pump & Mach. Corp.

Kilns
Allis-Chalmers Mfg. Co.
Ruggles-Coles Eng. Co.

Laboratory Supplies (see 'Assayers' and Chemists' Supplies')

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Flexible Steel Lacing Co.

Lamps, Arc and Incandescent
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Miners'
Bullard, E. D.

Lining for Ball-Mills
Fuller-Lehigh Co.
Hardinge Co.
Los Angeles Foundry Co.
Traylor Eng. & Mfg. Co.

Linings for Tube Mills
Fuller-Lehigh Co.

Locomotives, Compressed Air
Porter Co., H. K.

Locomotives, Electric
General Electric Co.
Morse Bros. Machy. & Supply Co.
Westinghouse Elec. & Mfg. Co.

Locomotives, Steam
Morse Bros. Machy. & Supply Co
Porter Co., H. K.

Lubricants
Chicago Pneumatic Tool Co.
Dixon Crucible Co., Joseph

Lubricators
Chicago Pneumatic Tool Co.
Lunkenheimer Co.
Powell Co., Wm.

Machinery, Used
Morse Bros. Machy. & Supply Co.
Nevada Engineering & Supply Co.
Pacific Pipe Co.

Magnesia Brick
Harbison-Walker Refractories Co.

Metal Buyers and Dealers
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American Zinc, Lead & Smelt. Co.
Atkins, Kroll & Co.
International Smelting Co.
U. S. Smelting, Ref. & Min. Co.
Wildberg Bros.

Mills—Ball, Pebble and Tube
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Denver Engineering Works Co.
Denver Fire Clay Co.
Hardinge Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Stearns-Roger Mfg. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Mills, Chilean
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Lane Mill & Machinery Co.
Morse Bros. Machy. & Supply Co
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Mills, Grinding
Fuller-Lehigh Co.

Mills, Stamp
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Morse Bros. Machy. & Supply Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Mine Doors
American Mine Door Co.

Motors
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Westinghouse Elec. & Mfg. Co.

Nodulizers, Ore
Allis-Chalmers Mfg. Co.

Office Supplies
Dixon Crucible Co., Joseph

Oil and Grease Cups (see 'Lubricators')

Oil Flotation
Barrett Co.
Florida Wood Products Co.
General Naval Stores
Hercules Powder Co.
Pensacola Tar & Turpentine Co.

Oil, Pine
Barrett Co.
Florida Wood Products Co.
General Naval Stores
Hercules Powder Co.
Pensacola Tar & Turpentine Co.

Ore-Buyers (see 'Metal Buyers and Dealers')

Ore Feeders
Buchanan Co., Inc., C. G.

Ore Testing Equipment
General Engineering Co.

Oxy-Acetylene Welding and Cutting Apparatus
Bullard, E. D.

Oxygen Apparatus
Bullard, E. D.

Packing
New York Belting & Packing Co.

Paints, Metal Protective
Dixon Crucible Co., Joseph

Paints, Preservative
Dixon Crucible Co., Joseph
Du Pont de Nemours & Co.
Filter Fabrics Co.

Pebbles
Atkins, Kroll & Co.
Hardinge Co.

Perforated Metals
Allis-Chalmers Mfg. Co.
Ludlow-Saylor Wire Co.
Meese & Gottfried Co.

Pipe Fittings
American Steel Foundries
Garratt & Co., W. T.
Lunkenheimer Co.
Merrill Co.
Pacific Pipe Co.
Pacific Tank & Pipe Co.
Powell Co., Wm.
Sacramento Pipe Works

Pipe, Cast Iron
Pacific Pipe Co.

Pipe, Riveted
American Spiral Pipe Works
Sacramento Pipe Works

Pipe, Standard Wrought
National Tube Co.
Pacific Pipe Co.

Pipe, Wood
National Tank & Pipe Co.
Pacific Tank & Pipe Co.

Placer Mining Machinery
Aldrich Pump Co.
American Spiral Pipe Works
Morse Bros. Machy. & Supply Co.
New York Engineering Co.
Union Construction Co.
Yuba Mfg. Co.

Pneumatic Tools
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Ingersoll-Rand Co.

Powder
Du Pont de Nemours & Co.
Hercules Powder Co.

Prospecting Supplies
Braun Corporation
Braun-Knecht-Heimann-Co.
Cochise Machine Co.
Denver Fire Clay Co.
Dobbins Core Drill Co.
Mine & Smelter Supply Co.
New York Engineering Co.
Rix Compressed Air & Drill Co.
Union Construction Co.

Pulleys, Magnetic
Buchanan Co., Inc., C. G.

Pulleys, Shafting and Hangers (see 'Transmission Machinery')

Pulverized Coal Installations
Fuller-Lehigh Co.

Pumps, Air Lift
Aldrich Pump Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Prescott Co.
Sullivan Machinery Co.
Traylor Eng. & Mfg. Co.

Pumps, Centrifugal
Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
Byron Jackson Iron Works
Fairbanks, Morse & Co.
Frenier & Sons
Garratt & Co., W. T.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Krogh Pump & Machinery Co.
Mine & Smelter Supply Co.
Meese & Gottfried Co.
Morse Bros. Machy. & Supply Co.
Oliver Continuous Filter Co.
Pacific Pipe Co.
Pelton Water Wheel Co.
Prescott Co.
Worthington Pump & Mach. Corp.
Yuba Mfg. Co.

Pumps, Reciprocating
Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Prescott Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp

Pumps, Vacuum
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Quicksilver
Atkins, Kroll & Co.
Braun Corporation
Braun-Knecht-Heimann-Co.
Bullard, E. D.
Denver Fire Clay Co.
Mine & Smelter Supply Co.

Railway Supplies and Equipment
American Mine Door Co.
American Steel Foundries
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Roadbuilding Material
Koppel Industrial Car & Equip. Co.

Rock Drills
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Cochise Machine Co.
General Electric Co.
Ingersoll-Rand Co.

Roller Bearings
Hyatt Roller Bearing Co.

Rolls, Crushing
Bacon, Inc., Earle C.
Buchanan Co., Inc., C. G.
Colorado Iron Works
Denver Engineering Works Co.
Fuller-Lehigh Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Roll Shells
Cambria Steel Co.

(Continued on page 34)

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If the price of an "Empire" were a hundred times what it is, it would still be the least expensive prospecting drill you could buy and use. And it is 95%, or more, accurate. See that your placer property is "Empire"-tested—it will save you money. Write for the Catalog.

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Two Extension Pockets for Trautwine or Field Books

THE · BUYER'S · GUIDE

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Denver Engineering Works Co.
Leschen & Sons Rope Co., A.
Meese & Gottfried Co.
Roebling's Sons Co., John A.
Williamsport Wire Rope Co.

Rubber Goods, Mechanical
New York Belting & Packing Co.

Safety Appliances
Bullard, E. D.

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Braun-Knecht-Heimann-Co.
Colorado Iron Works
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.

Saw Mill Machinery
Meese & Gottfried Co.
Prescott Co.

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American Steel Foundries
Braun Corporation
Braun-Knecht-Heimann-Co.
Colorado Iron Works
Denver Engineering Works Co.
James Ore Concentrator Co.
Ludlow-Saylor Wire Co.
Meese & Gottfried Co.
Stimpson Equipment Co.
Traylor Eng. & Mfg. Co.
Tyler Co., W. S.

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Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Screens, Revolving
Buchanan Co., Inc., C. G.

Screens, Rolled Slot
Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Screens, Wire
Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Separators
Buchanan Co., Inc., C. G.

Separators, Inclined Vibrating Screen
Tyler Co., W. S.

Shafting (see 'Transmission Machinery')

Shoes and Dies
Denver Engineering Works

Shovels, Electric and Steam
Leschen & Sons Rope Co., A.

Signal Systems, Alarm
Stromberg-Carlson Telephone Mfg. Co.

Silex
Atkins, Kroll & Co.
Hardinge Co.

Silica Brick
Harbison-Walker Refractories Co.

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American Zinc, Lead & Smelt. Co.
International Smelting Co.
U. S. Smelting, Ref. & Min. Co.
Wildberg Bros.

Smelting Machinery
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Dwight & Lloyd Sintering Co.
Greenawalt Sintering Apparatus
Morse Bros. Machy. & Supply Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Springs
American Spiral Pipe Works
American Steel Foundries
American Steel & Wire Co.

Steel, Drill
Cambria Steel Co.
Cochise Machine Co.
Colonial Steel Co.
Denver Rock Drill Mfg. Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Steel, Tool
Cambria Steel Co.
Colonial Steel Co.

Steel, Vanadium Drill
Colonial Steel Co.

Steel, Well Drilling
Colonial Steel Co.

Surveying Instruments
Braun Corporation
Braun-Knecht-Heimann-Co.
Broderick & Bascom Rope Co.

Switches
American Mine Door Co.

Tanks, Steel
Denver Engineering Works Co.
Ingersoll-Rand Co.

Tanks, Wood
Denver Engineering Works Co.
Morse Bros. Machy. & Sup. Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.

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Telephones, Iron Clad
Stromberg-Carlson Telephone Mfg. Co.

Testing Sieves and Testing Sieve Shakers
Tyler Co., W. S.

Thickeners, Pulp
Colorado Iron Works
Dorr Co.
National Tank & Pipe Co.
Oliver Continuous Filter Co.
Pacific Tank & Pipe Co.

Tools, Blacksmith
Ingersoll-Rand Co.

Tractors
Holt Manufacturing Co.
Yuba Mfg. Co.

Tramways, Aerial
American Steel & Wire Co.
Broderick & Bascom Rope Co.
Morse Bros. Machy. & Sup. Co.
Roebling's Sons Co., John A.
Williamsport Wire Rope Co.

Transmission Machinery
Allis-Chalmers Mfg. Co.
Meese & Gottfried Co.
Prescott Co.

Trucks, Motor (see 'Motor Trucks')

Tube-Mills (see 'Mills')

Turbines, Hydraulic
Allis-Chalmers Mfg. Co.
Pelton Water Wheel Co.

Turbines, Steam
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Valves
Crane Co.
Cleveland Rock Drill Co.
Lunkenheimer Co.
Merrill Co.
Powell Co., Wm.

Valves, Anti-Acid
Lunkenheimer Co.

Water Wheel, Impulse
Morse Bros. Machy. & Sup. Co.
Pelton Water Wheel Co.

Well Drilling Machy. and Supplies
Ingersoll-Rand Co.
Union Construction Co.

Wheels, Car
American Steel Foundries
Fuller-Lehigh Co.

Whistles
Lunkenheimer Co.
Powell Co., Wm.

Wire
American Steel & Wire Co.
Broderick & Bascom Rope Co.
Meese & Gottfried Co.
Roebling's Sons Co., John A.
Williamsport Wire Rope Co.

Wire Cloth
Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Wire, Insulated
General Electric Co.
Goodrich Rubber Co., B. F.
Roebling's Sons Co., John A.

Wire Rope Fittings
Broderick & Bascom Rope Co.
Leschen & Sons Rope Co.
Roebling's Sons Co., John A.
Williamsport Wire Rope Co.

Zinc Boxes
Colorado Iron Works
Mine & Smelter Supply Co.
National Tank & Pipe Co.
Traylor Eng. & Mfg. Co.

Zinc Dust and Shavings
American Zinc, Lead & Smelt. Co.
Atkins, Kroll & Co.
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Merrill Co.
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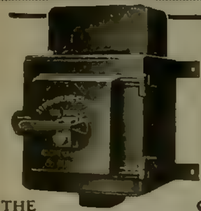

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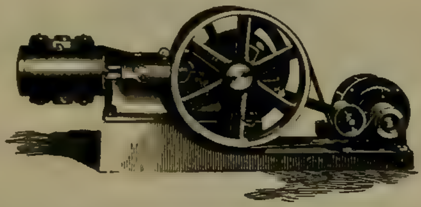

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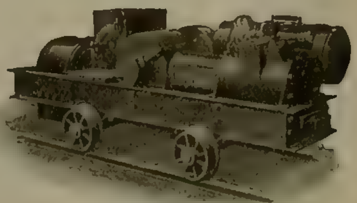

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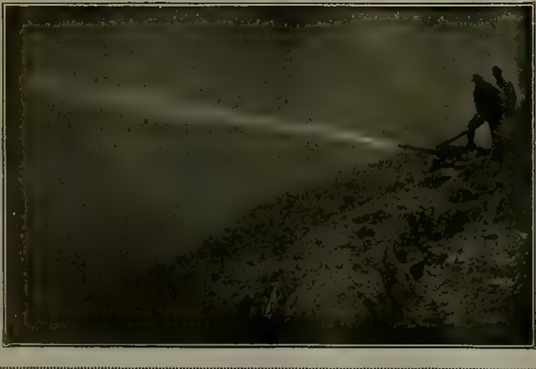

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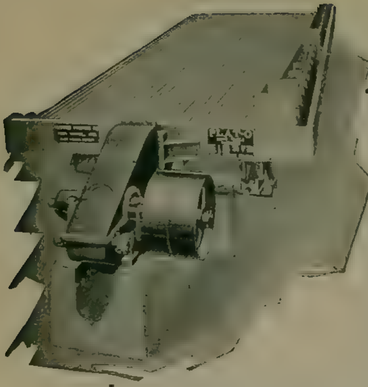

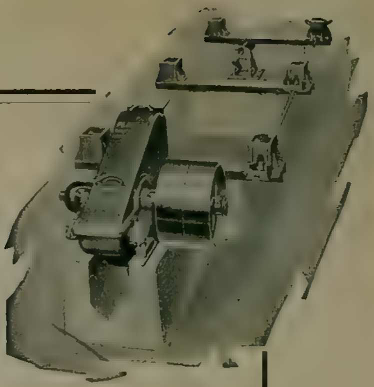

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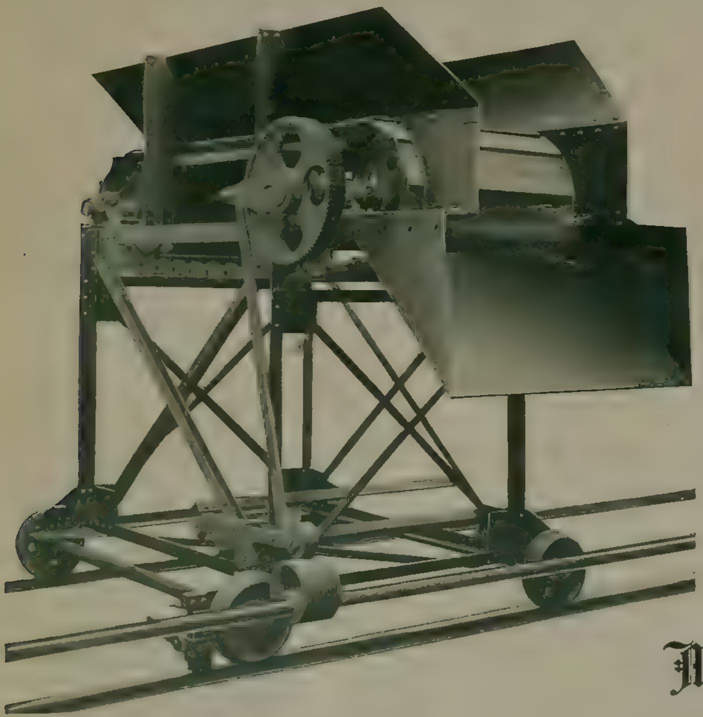

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